

Aquilegia

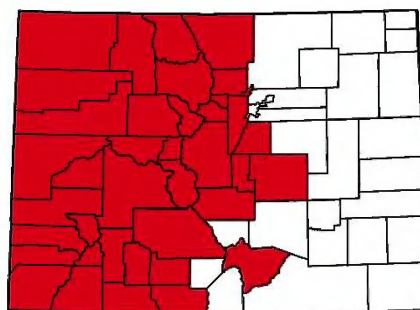
Magazine of the Colorado Native Plant Society

Volume 45 No. 1 Winter 2021





Prairie smoke, aka old man's whiskers, *Geum triflorum* (Rosaceae). Prairie smoke has a wide and diverse distribution—in Colorado, it can be found from 6,400-12,500 feet in elevation and in sagebrush flats, meadows, and along streams. It occurs in most of the western and northern states of the US and throughout most of Canada. A superficial look at the flowers might not immediately point one towards the Rosaceae family. However, the lovely plumose seedheads are quite similar to those of other members of this family. Prairie smoke is primarily cross-pollinated by bumblebees, which can force open the tightly-closed, downward-facing flowers. The persistent, mostly basal, leaves turn reddish in the fall and winter. The plant can be used as a ground cover in landscaping, as it spreads by rhizomes. It can be crowded out by taller plants, though. The boiled roots were used medicinally by Native Americans. Cover photo and the photo on this page © Marlene Borneman. KA



Map adapted from Ackerfield, J. *Flora of Colorado*, (2018), p. 725.

***Botanicum absurdum* by Rob Pudim**



It is with heavy hearts we say goodbye to **Mary Menz** as managing editor of *Aquilegia*. Under Mary's leadership, we updated the style and production quality of the magazine, standardized the format, went from a mostly black-and-white newsletter to a full-color magazine, and generally revitalized the magazine. On a personal note, she has been a wonderful mentor for introducing me to the world of journalism. We will miss her insight, botanical knowledge, attention to detail, and humor. On a brighter note, Mary will continue as an active member of CoNPS, putting more effort into West Slope activities. And continue to look for her name in future *Aquilegia* issues. All the best to you, Mary, in your future endeavors! – Kelly Ambler

Aquilegia: Magazine of the Colorado Native Plant Society

Dedicated to furthering the knowledge, appreciation, and conservation of native plants and habitats of Colorado through education, stewardship, and advocacy

Inside this Issue

Featured Story

- Those Pesky Weeds: A Short History of the Medicinal, the Noxious,
and the Edible Non-native Plants BY MARY MENZ 4

Research and Reports

- Establishing Native Plants in an Orchard to Enhance Ecological Systems BY EMILY LOCKARD..... 6

Columns

- Conservation Corner: Through the Loupe to the Landscape: Biodiversity from an
Ecological Perspective BY SIENNA WESSEL 10
- Garden Natives: The Woody Artemisias: Leaf Morphology and Physiology
Part 2 of a Series BY JIM BORLAND 14
- Pollinator Power: Not All Bees Are Created Equal: Honeybee Apiaries on Public Lands and
Consequences for Native Plants BY ELLIE STEVENSON 16
- Poetry: Love of Life BY ARTHUR CLIFFORD 19

News, Events, and Announcements

- Committee Updates 20
- Chapter Updates 21
- CoNPS Webinars 23
- Chapter Events 23
- Other CoNPS Events 25
- Cross Pollination Events 25
- In Memoriam: Gayle Weinstein BY JIM BORLAND AND RICK BRUNE 26
- In Memoriam: Jim Fuchs 27

Blast from the Past

- Dyeing with the Natives: *Artemisia* BY ANNE BLISS (1977) 28
- Dyeing with the Natives: *Salix amygdaloides* BY ANNE BLISS (1977)..... 28
- Can You ID these Seedheads? BY MARLENE BORNEMAN 31

AQUILEGIA: Magazine of the Colorado Native Plant Society
Aquilegia Vol. 45 No. 1 Winter 2021
ISSN 2161-7317 (Online) - ISSN 2162-0865 (Print) Copyright CoNPS © 2021
Members receive at least four regular issues per year (Spring, Summer, Fall, Winter). At times, issues may be combined. All contributions are subject to editing for brevity, grammar, and consistency, with final approval of substantive changes by the author. Articles from *Aquilegia* may be used by other native plant societies or non-profit groups if fully cited to the author and attributed to *Aquilegia*.
Managing/Design Editor: Kelly Ambler, alpineflowerchild@gmail.com
Assistant Editor: Nan Daniels
Botanical Names Editor: Elizabeth Taylor
Cartoonist: Rob Pudim
Proofreaders: Suzanne Dingwell, Cathi Schramm, Linda Smith, John Vickery

BOARD OF DIRECTORS

OPERATING COMMITTEE: Deryn Davidson, ddavidson@bouldercounty.org; Ann Grant, odygrant@gmail.com; **Secretary:** Amy Yarger, amy@bigempire.com; **Treasurer:** Mo Ewing, bayardewing@gmail.com

CHAPTER PRESIDENTS: **Boulder:** Patricia Butler, Lynn Riedel, Pam Sherman, Anna Theodorakos, Noonie Yaron, BoulderCoNPS@gmail.com; **Metro-Denver:** Dina Baker, Emily Clapper, Rahman Minhas, Lindsay Nerad, Rachel Puttmann, Audrey Spencer, metrodenverconps@gmail.com; **Northern:** Ann Grant on behalf of chapter leadership team, odygrant@gmail.com; **Plateau:** Jim Pisarowicz, jim.pisarowicz@gmail.com, David Varner, dvarner3@gmail.com; **Southeast:** Maggie Gaddis, ecocitycoloradosprings@gmail.com; **Southwest:** Anthony Culpepper, anthony@mountainstudies.org, Amanda Kuenzi, amandakuenzi@hotmail.com, Michael Remke, mremke@mountainstudies.org

DIRECTORS-AT-LARGE: Christina Alba, christina.alba@botanicgardens.org; Deryn Davidson, ddavidson@bouldercounty.org; Steve Olson, sdolsonoslods@aol.com; Anna Wilson, annabwilson@gmail.com; Tom Zeiner, tzeiner303@gmail.com

OTHER CONTACTS

COMMITTEE CHAIRS: **Conservation:** Mo Ewing, bayardewing@gmail.com; **Education & Outreach:** empty; **Field Studies:** Steve Olson, sdolsonoslods@aol.com, Lara Duran, ld.ecowise@gmail.com; **Finance:** Mo Ewing; **Horticulture:** Ann Grant, odygrant@gmail.com; **Media:** Deryn Davidson, ddavidson@bouldercounty.org, Lenore Mitchell, zap979sar@icloud.com, Steve Olson, sdolsonoslods@aol.com; **Research Grants:** Stephen Stern, stern.r.stephen@gmail.com; Christina Alba, christina.alba@botanicgardens.org; **Restoration:** Haley Stratton, hbstratton94@gmail.com; **Scholarships:** Cecily Mui, chmui@hotmail.com

SOCIAL MEDIA: **E-News Editor:** Linda Smith, conpsoffice@gmail.com; **Facebook:** Denise Wilson, conpspromote@gmail.com; Jen Boussetot, Jennifer.Boussetot@colostate.edu; Deryn Davidson, ddavidson@bouldercounty.org; Carol English, daleanana@gmail.com; Anna Wilson, annabwilson@gmail.com; Denise Wilson; Tom Zeiner, tzeiner303@gmail.com. **Twitter and Instagram:** Jen Boussetot, Denise Wilson; **Webmaster:** Mo Ewing, bayardewing@gmail.com

CoNPS PAID STAFF: Linda Smith, administrative coordinator, conpsoffice@gmail.com, 970-663-4085; Denise Wilson, marketing & events coordinator, conpspromote@gmail.com; Kathleen Okon, workshop coordinator, CoNPSworkshops@outlook.com

Featured Story

Those Pesky Weeds: A Short History of the Medicinal, the Noxious, and the Edible Non-native Plants

By Mary Menz

Weeds of the West defines a weed as any plant that interferes with management objectives for a given area of land. That explains why many natives are included in its pages, including wild licorice (*Glycyrrhiza lepidota*), scarlet globemallow (*Sphaeralcea coccinea*), and fireweed (*Chamerion angustifolium*) to name a few. These are plants that can interfere with crop health.

“Plants become weeds when they obstruct our plans, or our tidy maps of the world,” says Richard Mabey in the first line of his book *Weeds: In Defense of Nature’s Most Unloved Plants*. That one sentence describes weeds for most of us plant lovers. A weed is a plant that is just out of place. One gardener’s weed may be another person’s favorite flower—or food source.

Many of the non-native, invasive plants listed on the Colorado Department of Agriculture’s Noxious Weed Lists, for example, were brought to North America as food sources. Others hitched rides in seed mixes, purposely or not, or were introduced as windbreaks or erosion control. Even more were brought to the US as ornamental plants in the garden trade.

Medicinal Non-native Plants

Most of the species with the epithet *officinale* or *officinalis* in their names were originally sold in “herb stores,” or pharmacies of Europe. Dandelion (*Taraxacum officinale*) and watercress (*Nasturtium*

officinale) were both imported or brought from Eurasia—likely as medicinal or food sources. It was common for immigrants to post-colonial America to bring with them important items from their homelands. Other examples include lambsquarters (*Chenopodium album*), purslane (*Portulaca oleracea*), red and white clover (*Trifolium pratense* and *T. repens*), and burdock (*Arctium minus*) among others.

The *Chenopodium* and *Portulaca* species were introduced to the US as potherbs and, while non-native, they are not usually aggressive or invasive. The clovers were introduced as medicinal plants or as forage, and have spread to all states and Canadian provinces, but are not invasive, per se. Burdock, specifically, was so widespread in the US by 1663 that botanists mistakenly referred to it as a native species! These early colonists and settlers shared non-native plants and their uses with Native American Indian tribes as well, and many native people still refer to some non-native plants as common food sources. This information permeates oral history of the past three hundred years.

Noxious Non-native Plants

While many plants came to the US with a storied history of edible and medicinal uses, other non-natives, or “weeds,” came into the US in more unorthodox ways. ►



Common burdock (*Arctium minus*) leaves and seed heads. *Arctium* comes from the Greek word for bear, referring to the scruffy brown seed head. Another of its claims to fame is that its burrs provided the inspiration for Velcro®. Therein lies the rub. Its woody, hooked burrs provide the perfect method of seed dispersal—yet can severely devalue the wool of sheep in agricultural production, making it an agricultural nuisance and a List C weed on the Colorado Noxious Weed list, despite having been brought to the US as a human food source. © Mary Menz.

◀ Russian knapweed (*Acroptilon repens*, formerly *Centaurea repens*) was introduced to the Midwestern states in the late 19th century, likely in a mix of alfalfa seed from Kazakhstan or Uzbekistan. It now infests cropland in more than 46 states. The same is said for Russian thistle (*Salsola tragus*). It was introduced to the upper Midwest in a contaminated shipment of flax seed in 1893. Russian thistle, too, has spread to numerous states and Canadian provinces. The more moderate climate of the US encouraged these non-native plants to flourish and become invasive, and to tumble hither and yon while dispersing a prolific number of seeds that aid in their distribution.

Whether purposely introduced or not, non-native plant species can wreak havoc on a landscape. Consider Russian olive (*Elaeagnus angustifolia*) and downy brome (*Bromus tectorum*), also known as cheatgrass, among others. Russian olive was introduced to the US in the late 1800s as a windbreak. It took years to realize it was quickly proliferating and out-competing native species. Cheatgrass, too, was introduced purposely in a Washington state study on new grasses, though it likely arrived in the US in contaminated seed as well. Both species are considered invasive species worthy of eradication, though native birds spread the seed of Russian olive (Colorado List B) and cattle spread the seed of cheatgrass (Colorado List C), making eradication of both species nearly impossible.

And then there are the “ornamentals.” Yellow toadflax (*Linaria vulgaris*), leafy spurge (*Euphorbia esula*), oxeye daisy (*Leucanthemum vulgare*) and many more non-native plants were brought to the US as ornamental or garden plants. Some were dumped in ballast waste on the shores of the US and then assumed to be native until it was proven otherwise. Others were marketed in containers with tags that enticed buyers to plant them in their home gardens.

Edible Non-native Plants

For List C weeds that can never be completely eradicated—like burdock and chicory—some people have turned to an earth-friendly method of management. They eat them. Consider it a yard-to-table movement. For example, common burdock’s roots, peeled stems, and early leaves are edible. There is also a long history of people making a combination burdock-dandelion beer.

Other non-native—yet not “noxious”—weedy species are so pervasive and naturalized they aren’t even on the Noxious Weeds List. Dandelion (*Taraxacum officinale*) comes to mind. Considered obnoxious by any lawn lover, it provides a good source of edible or medicinal leaves, flowers, and roots. It was brought to the US in the mid-1600s for that very reason. Picking

dandelion flowers when fresh and sautéing them with butter makes a delicious side dish. The tender young leaves, when picked in the morning, are good in a salad and better in a pesto. The dried roots can be used in a lightly stimulating tea.

“Eat your weeds”... continued on page 13 ►

Noxious Weeds in Colorado

By definition, a noxious weed in Colorado is “an alien plant or parts of an alien plant that have been designated by rule as being noxious or has been declared a noxious weed by a local advisory board.”

Weeds on the Colorado Noxious Weed Lists are those that can be aggressive and compete with native plant populations for valuable soil and water resources. They can also infest agricultural crops and create health risks for cattle and other livestock. Some noxious weeds also can carry detrimental insects, diseases, or parasites. That’s why each county may also have its own noxious weed list managed by a county weed manager who is guided by a county weed board.

Colorado separates noxious weeds into four categories:

- List A weeds are not widespread and must be reported and eradicated immediately. All are exotic and may spread quickly;
- List B weeds are more widespread and common, and state plans have been made to control the spread of these plants;
- List C weeds are often naturalized and cannot be eradicated; however, they should be contained as much as possible. The state provides resources for management; and
- Watch list weeds are those that may be seen in surrounding states or those that may pose a significant threat for spreading into Colorado.

“The goal for List C species is to encourage control of them,” said Steve Ryder, state weed coordinator for the Colorado Department of Agriculture. He explained that individual counties can advocate for specific management methods, including chemical, mechanical (mowing or pulling), or by using biological controls (insects) to strategically manage them in specific areas.

Steve emphasized the recognized plant-out-of-place conundrum. “Wild proso millet [*Panicum miliaceum*] is a recognized ag crop in Colorado, yet it’s a C List weed because it’s aggressive and takes over in non-crop areas.”

Research and Reports

Establishing Native Plants in an Orchard to Enhance Ecological Systems

By Emily Lockard

CoNPS annually funds grants to support field and laboratory research as part of its John W. Marr and Myrna P. Steinkamp grant programs. Reporting on projects is a requirement of all grant recipients. In this issue, we are pleased to feature this report by Emily Lockard.

This project demonstrates the use of native plants in a fruit tree orchard. We propose that appropriate native plants can enhance ecological systems through lower water requirements and by supporting pollinator populations, which also support agricultural production. We demonstrated this through the establishment of native grasses and forbs in an experimental fruit tree orchard located in Yellow Jacket, Colorado.

Orchards are a historic and active part of the agricultural community in southwestern Colorado. The Southwestern Colorado Research Center in Yellow Jacket has a three-acre orchard that is managed by personnel from Colorado State University Extension in Montezuma and Dolores Counties and the SWCRC. The goal of the orchard is to be a regional resource, including testing varieties adapted to our high-elevation environment and demonstrating modern management techniques. The orchard includes 21 field and 43 trellised apple varieties, two apple varieties planted in “super high density,” five peach, four pear, and three plum varieties. Grasses were planted between the rows of orchard trees in 1993 and 1995 to suppress weeds and demonstrate grass performance in an orchard. At close to 30 years old, most of the grass plantings were spotty and weedy. One of the goals is to be a wise steward of water, so the grasses between rows were not irrigated. We decided to plant new grasses, and we wanted not to

irrigate grasses once they were established so we selected drought tolerant native grass varieties.

To remove old grass stands and weeds, we planned to use glyphosate in August 2019, but due to extremely dry conditions the grasses had gone dormant and there would have been little control of the old grasses and weeds. Instead on November 18, 2019 we roto-tilled the rows to break up the root crowns of the old grasses and to kill the existing weeds. We planted grasses with a Great Plains grain drill on November 19, 2019 as a dormant planting, and it snowed on November 20. The following species were planted as monocultures in individual orchard rows approximately 14 feet wide by 200 feet long: *Bouteloua gracilis* (blue grama), *B. curtipendula* (sideoats grama), *Buchloe dactyloides* (buffalograss), *Elymus lanceolatus* (thickspike wheatgrass), *Pascopyrum smithii* (western wheatgrass), *E. lanceolatus* ssp. *riparius* (streambank wheatgrass), and *Hilaria jamesii* (James' galleta). Mixes of grasses were planted in one row with *B. gracilis* and *B. dactyloides* and another row with *E. lanceolatus*, *P. smithii*, and *E. lanceolatus* ssp. *riparius*.

The winter of 2019-2020 was dry with little snow. To help with establishment, grasses were watered starting in early June. Individual rows were watered every two weeks until mid-September. Line point transects completed in July and September show that some grasses established better in the first year than others, with weeds and bare ground a concern. Rows were mowed throughout the season for weed management and to allow equipment access to the orchard.

The orchard is not grazed, but we wanted to demonstrate the possible benefits of native grasses that could be grazed by livestock. We took hoop clippings and submitted them for nutritional analysis. Livestock can keep the grasses to a reasonable height without requiring the inputs related to mowing. Sheep would be preferred to cattle or goats for grazing in an orchard because of the reduced risk of damage to trees.

We also wanted to establish native forbs that could extend the time of available food for pollinators in the area. The bloom time on fruit trees is limited, but bees play an important role in pollination for fruit production. There is alfalfa nearby, but it blooms in a cyclical manner because it is harvested multiple times a year. ►



Great Plains grain drill planting in the orchard (November 19, 2019). © Emily Lockard



Forb seeding (July 31, 2019). © Emily Lockard

◀ This means there is a lack of a constant food source throughout the growing season. We selected native forbs as pollinator species because we wanted to find species that also do well with limited irrigation. We planted five native forbs: *Ratibida columnifera* (Mexican hat cone flower), *Penstemon strictus* (Rocky Mountain penstemon), *P. palmeri* (Palmer penstemon), *Sphaeralcea munroana* (Munro's

globemallow), *Hedysarum boreale* (Utah sweetvetch), and *Linum lewisii* (Lewis flax).

We planted the native forbs adjacent to the orchard with a 6-row plot planter in November 2019 in a dormant planting. Native forb seed can be very expensive and the plot planter reduced the amount of seed necessary, which reduced costs. Normally we can use our plot planter for plots measuring 6X30-ft, but the plot planter did not work as well as we had hoped due to static electricity. Some small seeds stuck to the sides of the metal cone on the planter. We had planned different mixes in our planting, but this did not work as intended. It is unfortunate that we cannot compare individual plot mixes, but the seed did get planted. We collected line point intercept data in each plot and can show how the populations changed over the growing season.

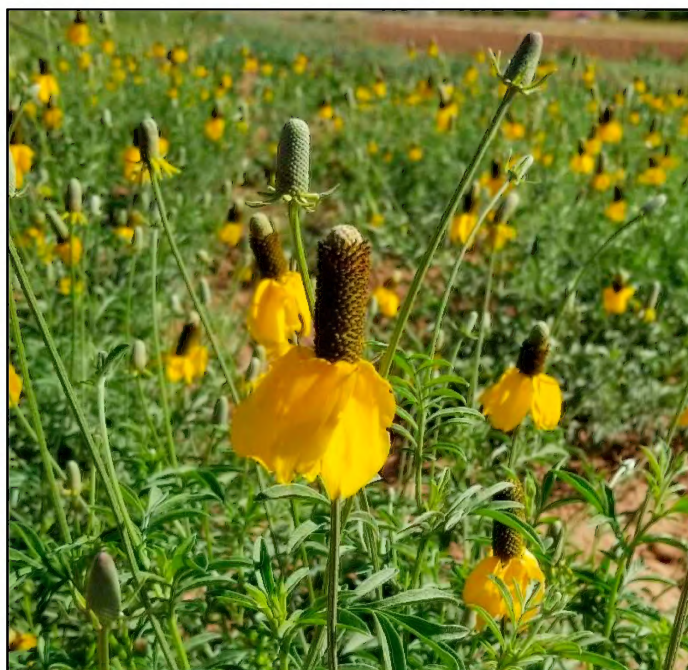
To document the changes in plant composition where we seeded grasses, we conducted a 50-ft line point transect and photo points in each row in July and September. To determine the forage quality of each planting, we took grass clippings in September and sent them for analysis. Hoop clippings reflect standing biomass and are not a reflection of total production because the rows were mowed. Crude protein is a significant factor to use while evaluating forage quality for grazing. Depending on growth stage or lactation status, sheep and cattle need feeds that are approximately between seven to 17% CP. The forage testing results show that native grasses can meet ►

Table 1. Cover of seeded native grasses, non-native weeds and bare ground at the middle (July) and end (September) of the growing season; and crude protein (dry basis) and standing crop at the end of the growing season in the orchard rows at the Southwestern Colorado Research Center in 2020.

Grass in row	Grass Cover July (%)	Weeds Cover July (%)	Bare Ground July (%)	Weeds Cover Sept. (%)	Bare Ground Sept. (%)	Grass Cover Sept. (%)	Crude Protein dry basis (%)	Standing Crop Sept. (lb/acre)
Blue grama	0	6	92	34	0	54	16.2	140
Sideoats grama	0	64	36	64	4	30	12.7	130
Thickspike wheatgrass	0	14	64	58	6	34	20.1	270
Western wheatgrass	24	62	10	36	0	2	19.9	295
James' galleta	0	72	28	82	0	16	17.6	350
Buffalograss	0	60	40	90	0	10	20.3	195
Streambank wheatgrass	30	26	44	24	24	32	26.3	460
Blue grama and buffalograss	8	32	60	40	0	50	n/a	775
Thickspike, streambank and western wheatgrass	10	84	6	58	0	28	n/a	370



Honeybee visiting Munro's globemallow (October 15, 2020). © Emily Lockard



Mexican hat coneflower (July 20, 2020). © Emily Lockard

◀ or exceed the nutritional requirements for grazing animals during the growing season.

In the second year of growth we expect that the grasses will better outcompete weeds and that bare ground will decrease. Both weeds and bare ground were the largest percentage in our line point transects besides grasses. We will continue to water in the second year as needed, but the goal is to stop or reduce watering between rows once the grasses are established.

Despite our challenges planting forbs, we were impressed with their establishment. The forbs were hand hoed for weed control and watered with a side roll to improve first year establishment. Forb species were selected for the timing of flowering to provide a food source for pollinators throughout the growing season. Blue flax was the first to flower in June followed by Mexican hat cone flower, Munro's globemallow, and Rocky Mountain penstemon. Utah sweetvetch grew vegetatively throughout the planting and flowered very briefly in July. Palmer penstemon grew vegetatively and only a few plants flowered in September and October.

We documented change in vegetative cover through 20-ft line point transects done in July and September. Cover of most of the seeded forbs increased over the season: a 1.6% increase of Mexican hat coneflower, 0.3% increase of Rocky Mountain penstemon, 7.1% increase of Palmer penstemon, 1.5% increase of Lewis flax, 18.8% increase of Munro's globemallow; but a 2.0% decrease of Utah sweetvetch. Weed cover decreased 30.3%. We established photo points to document forb composition changes over time, taking photos in each plot in July and September. Visual assessments of Lewis flax, Munro's globemallow, Mexican hat coneflower, and Rocky Mountain penstemon indicate they all established and bloomed successfully. Utah sweetvetch and Palmer penstemon established at lower rates and didn't bloom as much as the other forbs. We are eager to see how all of the forbs perform in the second year.

We will continue to monitor the grass and forb plantings to evaluate their performance in future years. We hope to expand the grass plantings to rows that we did not seed in 2019. We plan to manage the forb planting as a permanent perennial forb planting, ▶

Table 2. Blooms of native forbs seeded at the Southwestern Colorado Research Center in 2020, observed by month.

Forb	June	July	August	Sept	October
Lewis flax					
Rocky Mountain penstemon					
Palmer penstemon					
Munro's globemallow					
Utah sweetvetch					
Mexican hat coneflower					



Rocky Mountain penstemon (Aug 10, 2020).
© Emily Lockard



Orchard row 10 photo point (September 8, 2020).
© Emily Lockard

◀ and we will monitor the performance of each forb to see how rates of bloom change versus vegetative growth we measured this year. If you are interested in visiting in 2021 please reach out to learn how to safely visit while following current public health guidelines. We hope we can safely welcome you soon!

Acknowledgements

Special thanks to Jerry Mahaffey, Gus Westerman, Cindy Vermeule, and Neeta Mahaffey for their help planting this project. Thank you to Emma Youngquist and Joe Breen who tirelessly moved water.

Author Bio

Emily Lockard is a research associate with Colorado State University at the Southwestern Colorado Research Center in Yellow Jacket. She has a B.S. in Animal Science and an M.S. in Range Science. Her interest in native plants began as a child exploring Yosemite National Park, expanded as an extension agent in Pueblo, Colorado and Bozeman, Montana working on grazing management with ranchers and continues as she applies her interest in native plants to cropping and rangeland management research.
Emily.Lockard@colostate.edu

Resources

Colorado Resource Monitoring Initiative. Colorado Rangeland Monitoring Guide. 2014.

https://www.onpasture.com/wp-content/uploads/2017/03/RangelandMonitoringGuide-Web_2-Version.pdf

Decourtye A, Mader E, and Desneux N. (2010) Landscape enhancement of floral resources for honey bees in agro-ecosystems. *Apidologie*. 41:264–277.

Jurgens MH. (2002). *Animal Feeding and Nutrition*. Kendall/Hunt Publishing Company.

Palladini JD and Maron JL. (2014) Reproduction and survival of a solitary bee along native and exotic floral resource gradients. *Oecologia*, 176:789-798.

Roper TR, Rowley M, Black B and Murray M. (2012) Chapter 7. Orchard floor and weed management. *Utah-Colorado Commercial Tree Fruit Production Guide*.

Rowley MA. (2011) Orchard Floor Management. Utah State University. M.S. Thesis 1103.

<https://digitalcommons.usu.edu/etd/1103>

Wratten SD, Gillespie M, Decourtye A, Mader E, and Desneux N. (2012) Pollinator habitat enhancement: Benefits to other ecosystem services. *Agriculture, Ecosystems and Environment*. 159: 112-122.

Westerman G and Hooten T. (2018) Yellow Jacket Fruit Tree and Vineyard Research and Demonstration Project: 2018 Report. <https://aes-swrcr.agsci.colostate.edu/wp-content/uploads/sites/92/2019/03/2018-Orchard-report-for-SWCRRC.pdf>.

Through the Loupe to the Landscape: Biodiversity from an Ecological Perspective

By Sienna Wessel

My interest in botany drove me with a fervent passion to learn the names and taxonomic classifications of every plant I encountered. Soon after, a desire to protect these plants

drove me to focus more on the variation of morphological features such as leaf size, seed shape, and root length. My view of plant diversity has subsequently shifted into a mode of “reading plant traits” which tell stories of plant strategies and survival that I hope can lead us into a new era in the struggle to conserve and restore plants. I like to think of this perspective as “looking through the loupe to the landscape.” We, as plant enthusiasts and botanists, already use the loupe to pinpoint unique plant features in order to key out a species, but we can also use some of these features to gain a deeper understanding of plant ecology.

When I look at something as simple as leaf size and structure, I see underlying information about a plant’s resource investments, survival strategies, and tolerance of stress. A very simplified example of this concept can be seen when considering the heavy dominance of needle-leaved evergreens such as *Pseudotsuga menziesii* (Douglas fir) and *Pinus ponderosa* (ponderosa pine) in Colorado, with only a few broad-leaved deciduous species like *Populus tremuloides* (quaking aspen) sharing a similarly wide distribution (Figure 1). The dichotomy of these general

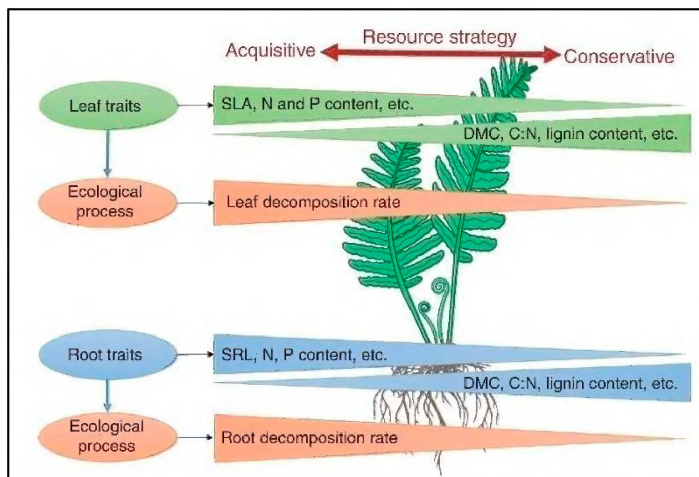


Figure 2. Figurative depiction of the hypothetical spectrum of leaf economics and associated functional traits. SLA, specific leaf area; SRL, specific root length; DMC, leaf dry matter content; C, carbon; N, nitrogen; P, phosphorus. Source: Lin et al. 2019

leaf types in essence represents an “economic” spectrum (Figure 2, Lin et al. 2020) where plants must balance investments in new leaf construction and the resulting potential for photosynthesis with cold tolerance (Bai et al. 2015, Ge and Xie 2017, Wright et al. 2004). Short growing seasons across Colorado favor traits which allow a long leaf life span under unfavorable conditions (e.g., narrow, waxy needles) because the costs of new seasonal leaf production versus carbon captured during the growing season alone would lead to a “negative balance in the bank.” These types of morphological plant traits are a mark left by evolutionary and ecological processes that dictate the environmental conditions a plant can tolerate and shape the distribution of a species on the landscape. The official term for this ecological perspective of biodiversity is “functional trait ecology,” with the term “trait” referring to any physiological feature that directly impacts the fitness (collectively survival, growth, and reproduction) of a plant (Violle et al. 2007).

Two great challenges for conservationists and restoration ecologists are (1) the need to predict the future fates of plant populations or communities and (2) the requirement to make quick decisions on a dime. It takes a considerable amount of time and money to learn the total life history and ecological strategy of every plant species and to track change ►



Figure 1. Common Colorado tree species representing divergent resource investments and survival strategies that result in very different leaf morphologies. Left: *Pseudotsuga menziesii*, Douglas fir. Right: *Populus tremuloides*, quaking aspen. Photo Credit: Wikimedia Commons

◀ over time. Of course, we should continue to invest in invaluable, high-detail monitoring projects whenever possible, but ever-increasing limitations driven by reductions in funding and staffing can force botanists to pick and choose which plant species get attention each year. Trait ecology provides hope for the preservation of plant biodiversity at larger scales and with fewer resources, because it focuses on traits that occur across species and ecosystems. The field is still young and learning but is ripe with hope that traits can help botanists and ecologists predict how plants will respond to new or changing environments. Trait ecologists around the world are contributing trait measurements to huge databases like the TRY plant-based database, allowing for the global mapping of trait distributions and the synthesis of trait information with other data such as vital rates (e.g., survival, reproduction) of rare species or monitoring data on restored communities. For example, Peter Adler and colleagues combined TRY trait data with population models for 222 plant species from the COMPADRE Plant Matrix Database and determined that traits

accurately represented whole plant life-history strategies (e.g., slow and conservative vs. fast and acquisitive) *and* were related to vital rate elasticities (Figure 3, Adler et al. 2014). This is promising news for the application of traits to conservation because vital rate elasticity, or the proportional change in the population growth rate for a proportional change in a vital rate, is commonly used to identify population trends and understand what life stages are most sensitive to stressors (Benton and Grant 2000).

In Colorado, researchers are actively applying trait perspectives to study plant responses to climate change, restoration success, and plant community dynamics, to name a few focal areas. The Rocky Mountain Biological Laboratory in Gothic, CO alone has hosted a number of researchers working on plant trait studies. Dr. Benjamin Blonder's program at RMBL has found success in predicting alpine plant community dynamics using plant traits and microclimate data (Blonder et al. 2018) while Dr. Aimée Classen's research program has been tackling questions related to the dependence of plant responses to warming on functional traits, for a couple of examples. Further north at University of Colorado Boulder, Dr. Katharine Suding has acted as a leader in the march to incorporate traits into community ecology by developing a conceptual framework for field researchers to test trait-based predictions of plant responses to the environment as well as the resulting effects on ecosystem functioning (Suding et al. 2008).

Through my own plant trait research, I hope to improve predictability and stability of sagebrush ▶



Figure 3. Rehydrating morphologically diverse leaf samples taken from the field. This is part of the process for calculating specific leaf area (SLA), a functional trait which helps ecologists locate a plant species along an ecological spectrum ranging from conservative to resource acquisitive plant strategies. Adler et al. 2014 selected SLA as one trait for their study. © Sienna Wessel

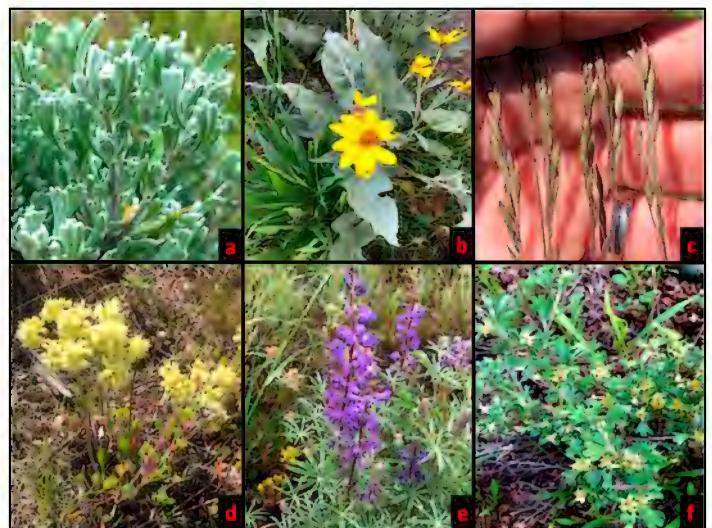
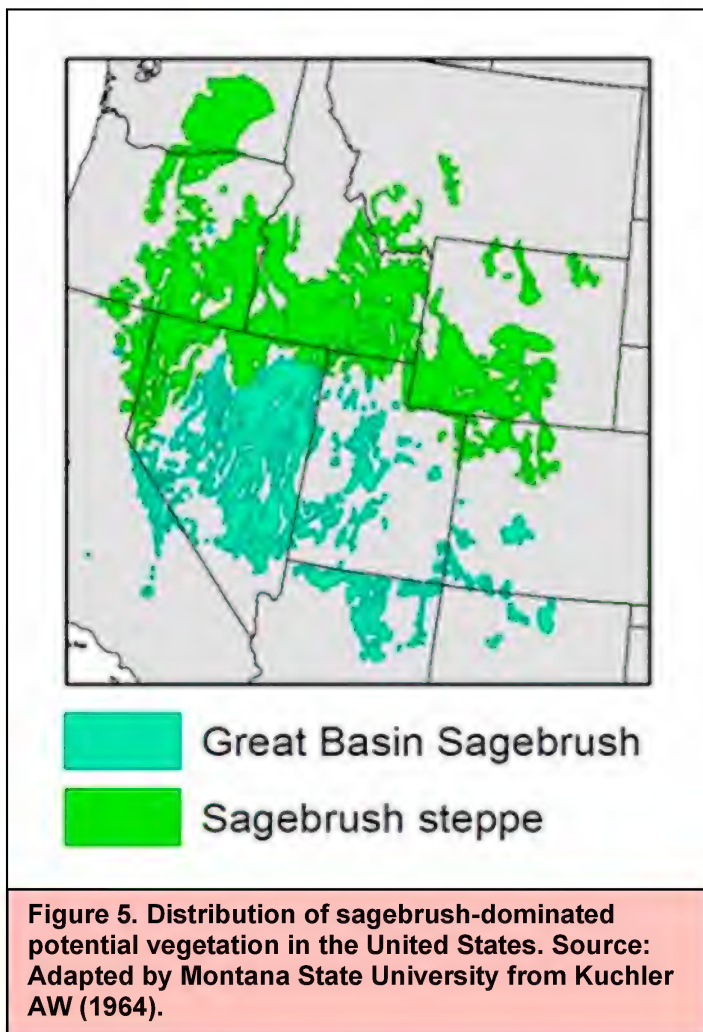


Figure 4. Species common to the Intermountain Sagebrush Steppe of Wyoming and Colorado include a. *Artemisia tridentata* var. *vaseyana*, b. *Balsamorhiza sagittata*, c. *Festuca idahoensis*, d. *Eriogonum umbellatum*, e. *Lupinus argenteus*, f. *Purshia tridentata*. These communities can be quite diverse compared to the drier sagebrush shrublands of the Great Basin. © Sienna Wessel



◀ steppe restoration in the face of increasing climatic change. Although I conduct my research in Grand Teton National Park, WY, similar sagebrush communities and associated species (Figure 4), including *Artemisia tridentata* var. *vaseyana* (big sagebrush), *Eriogonum umbellatum* (sulfur flower), *Festuca idahoensis* (Idaho fescue), *Purshia tridentata* (antelope brush), and *Lupinus argenteus* (silvery lupine), can also be found throughout Colorado's Western Slope (Figure 5). I spent last summer measuring plant traits such as seed mass, mature height, leaf area, and earliest flowering date on 70+ species. I am now creating models to determine if these traits are good predictors of:

- Establishment and persistence in restored communities;
- Population level responses to fluctuating precipitation and temperature; and
- Stability (decreased variation of total plant cover) of whole communities to climatic fluctuation.

If traits are successful predictors, they could be useful for the preservation of sagebrush communities which have already been converted or degraded in over 50% of their original range (Pyke et al. 2015). For example, seed mixes could be designed based on a diversity of

traits that will lead to quick establishment and climate resilience. Additionally, if we know which traits do poorly under certain environmental/climatic conditions or do not establish well during restoration, we can shift attention and resources to species-specific management efforts to encourage population persistence.

All in all, trait-based perspectives could be a useful tool-in-the-box for the protection of plant biodiversity, particularly in combination with species-focused agendas. Current work has largely focused on understanding and predicting community assembly, with applied perspectives interested in improving restoration outcomes. The scope of trait ecology research could widen to include a greater focus on conservation perspectives, such as the application of trait-based predictions to estimate population level change and to identify the most at-risk populations. Discoveries in trait ecology are also limited by gaps in trait data, leaving opportunities for the development of citizen science initiatives to measure traits which do not require specialty equipment. Next time you are out in the field, I hope that you are inspired to take a moment to “look through the loupe to the landscape” and unlock some of the ecological secrets held in the amazing morphological variation you see.

Sienna Wessel is a master's student at the University of Wyoming studying in the lab of Dr. Daniel Laughlin. She is passionate about the application of ecological science to the preservation of plant biodiversity. Sienna has worked on a variety of restoration and community monitoring projects for agencies such as The Nature Conservancy and U.S. Fish and Wildlife Service, and she now works on sagebrush steppe restoration and community ecology in Grand Teton National Park for her thesis work. She plans to expand her experience post-graduation by pursuing work on projects related to floristics, rare plants, population ecology, and climate change. You can follow her work on Instagram @cutting_veg_botany, Twitter @CuttingVegBotny and on the web at www.cuttingvegbotany.com.

References

- Adler, P. B., R. Salguero-Gómez, A. Compagnoni, J. S. Hsu, J. Ray-Mukherjee, C. Mbeau-Ache, and M. Franco. 2014. Functional traits explain variation in plant life history strategies. *Proceedings of the National Academy of Sciences of the United States of America* 111:740–745.
- Bai K, He C, Wan X, and Jiang D. (2015) Leaf economics of evergreen and deciduous tree species along an elevational gradient in a subtropical mountain. *AoB PLANTS* 7. doi: 10.1093/aobpla/plv064
- Benton, T. G., and A. Grant. (1999) Elasticity analysis as an important tool in evolutionary and population ecology. *Trends Ecol Evol.* 14:467–471.
- Blonder B, Kapas RE, Dalton RM, Graae BJ, Heiling JM, and Opedal ØH. (2018) Microenvironment and ►

◀ functional-trait context dependence predict alpine plant community dynamics. *J Ecol.* 106:1323–1337.

Chambers JC, Maestas JD, Pyke DA, Boyd CS, Pellant M, and Wuenschel A. (2017) Using Resilience and Resistance Concepts to Manage Persistent Threats to Sagebrush Ecosystems and Greater Sage-grouse. *Rangeland Ecology and Management* 70:149–164.

Ge J and Xie Z. (2017) Geographical and climatic gradients of evergreen versus deciduous broad-leaved tree species in subtropical China: Implications for the definition of the mixed forest. *Ecol Evol.* 7:3636–3644.

Kattge J, et al. 2011. TRY - a global database of plant traits. *Global Change Biology* 17:2905–2935.

Lin D, Yang S, Dou P, Wang H, Wang F, Qian S, Yang G, Zhao L, Yang Y, and Fanin N. 2020. A plant economics spectrum of litter decomposition among coexisting fern species in a sub-tropical forest. *Annals of Botany* 125:145–155.

Pyke DA, Chambers JC, Pellant M, Knick ST, Miller RF, Beck JL, Doescher PS, Schupp EW, Roundy BA, Brunson M, and McIver JD. (2015) Restoration handbook for sagebrush steppe ecosystems with emphasis on greater sage-grouse habitat—Part 1. Concepts for understanding and applying restoration. *U.S. Geological Survey Circular* 1416: 1-44.

Salguero-Gómez R, Jones OR, Archer CR, Buckley YM, Che-Castaldo J, Caswell H, Hodgson D, Scheuerlein A, Conde DA, Brinks E, de Buhr H, Farack C, Gottschalk F, Hartmann A, Henning A, Hoppe G, Römer G, Runge J, Ruoff T, Wille J, Zeh S, Davison R, Viereggs D, Baudisch A, Altwegg R, Colchero F, Dong M, de Kroon H, Lebreton JD, Metcalf CJE, Neel MM, Parker IM, Takada T, Valverde T, Vélez-Espino LA, Wardle GM, Franco M, and Vaupel JW. (2015) The COMPADRE Plant Matrix Database: An open online repository for plant demography. *J Ecol.* 103:202–218.

Suding KN, Lavorel S, Chapin FS, Cornelissen JHC, Díaz S, Garnier E, Goldberg D, Hooper DU, Jackson ST, and Navas NL. (2008) Scaling environmental change through the community-level: A trait-based response-and-effect framework for plants. *Global Change Biol.* 14:1125–1140.

Violle C, Navas ML, Vile D, Kazakou E, Fortunel C, Hummel I, and Garnier E. (2007) Let the concept of trait be functional! *Oikos.* 116:882-892.

Wright IJ, Reich PB, Westoby M, Ackerly DD, Baruch Z, Bongers F, Cavender-Bares J, Chapin T, Cornelissen JHC, Diemer M, Flexas J, Garnier E, Groom PK, Gulias J, Hikosaka K, Lamont BB, Lee T, Lee W, Lusk C, Midgley J, Navas ML, Niinemets U, Oleksyn J, Osada N, Poorter H, Poot P, Prior L, Pyankov VI, Roumet C, Thomas SC, Tjoelker MG, Veneklaas EJ, and Villar R. (2004) The worldwide leaf economics spectrum. *Nature* 428:821-7. 🌀

◀ continued from page 5 ...“Eat your weeds”

Chicory (*Chicorium intybus*), too, has been rediscovered as a coffee substitute, or at least a coffee additive. Originally introduced to the US in the 1700s, chicory became quite important to the residents of Louisiana when coffee imports were blocked to the South during the Civil War. Modern day foragers mix dried chicory root with their coffee or make a dandelion-chicory root tea. The young shoots and leaves are also used as salad greens.

Apparently, even field bindweed (*Convolvulus arvensis*) is edible, but is said to have extreme laxative effects. If you choose eating weeds as a management method, do your homework!

Mary Menz is a career writer with a serious native plant hobby. She was Managing Editor of Aquilegia for 3 years before retiring from this position at the end of 2020. As a Colorado Native Plant Master® who teaches on the Western Slope, she advocates that noxious weeds be managed appropriately. She admits to having pulled out a knife to share a taste of the celery-like stem of List B musk thistle (Carduus nutans) with students—but recommends doing this only when wearing leather gloves! After any taste test, she pulls the entire plant from the ground and places it in a bag to dispose of properly before it goes to seed.

Resources

Colorado Department of Agriculture, Noxious Weed Program. Noxious Weeds

<https://www.colorado.gov/agconservation/noxiousweeds>

Eat the Weeds and Other Things, too.

<http://eattheweeds.com>

Gladstar R. (2012) *Medicinal Herbs: A Beginner's Guide*. Storey Publishing. North Adams, MA.

Kalusová V, Chytrý M, van Kleunen M, Mucina L, Dawson W, Essl F, Kreft H, Pergl J, Weigelt P, Winter M, and Pyšek P. (2017) Naturalization of European plants on other continents: The role of donor habitats. *Proc Natl Acad Sci USA* Vol 114 DOI 10.1073/pnas.1705487114.

LatDict, Latin Dictionary and Grammar Resources.

<https://latin-dictionary.net/definition/39120/vulgaris-vulgare>

Mabey R. *Weeds: In Defense of Nature's Most Unloved Plants*. HarperCollins Publishers. New York, 2010.

Stearn WT. *Botanical Latin* (fourth edition). Timber Press. Portland, OR. 2004.

The Ohio State University College of Food, Agriculture, and Environmental Science “Ohio Perennial and Biennial Weed Guide.” https://www.oardc.ohio-state.edu/weedguide/single_weed.php?id=16#:~:text=Origin%20and%20Distribution%3A,it%20as%20a%20native%20species 🌀

The Woody Artemisias: Leaf Morphology and Physiology Part 2 of a Series

By Jim Borland

This is part two in a multi-part series of articles on the Artemisia genus and its species. Common names include sagebrush, wormwood, and mugworts. This article describes some of the variations found in Artemisia leaves. Part three will be published in the Spring 2021 issue of Aquilegia.

The usual botanical floral markers are used to taxonomically assign members to a species, but since the flowers of artemisias are so small, other botanical features and ecological associations are also used. Differences among this group of lookalikes include:

- Number of flowers to a head;
- Size and shape of leaves, which differ from one portion of the shrub to another and can be ephemeral or persistent;
- Fertility or sterility of individual flowers;
- Palatability to wildlife;
- Adaptability to soil depth;
- Structure;
- Drainage and chemistry;
- Elevation differences;
- Crude protein;
- Monoterpenoid content; and
- Tendency to natural layering.

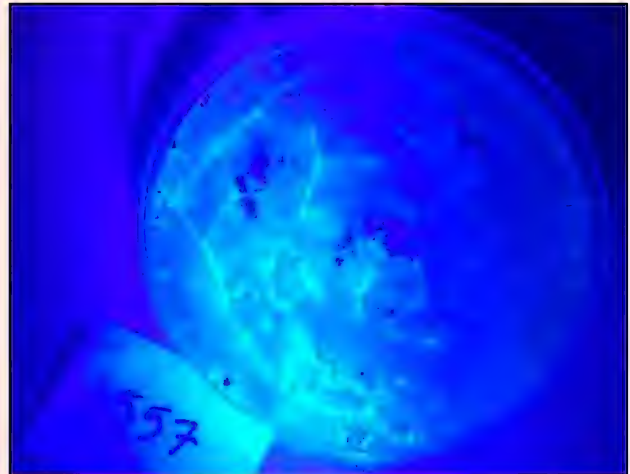
Identifications have proven difficult enough that a simple chemical test has been devised to aid in the identification of a few species. This test involves soaking a few grams of leaves or seeds in a small quantity of methanol or ethanol in a clear bottle for one hour. The solution is then irradiated with a simple ultraviolet lamp and the resulting fluorescence is either a characteristic creamy-blue or brownish-red color. See the sidebar for an example.

The evergreen members of the *Artemisia* genus have the ability to manufacture food at temperatures only slightly above freezing, thus allowing them to get a head start on the growing season. This ability undoubtedly enables many of the more xeric species to utilize the usually more abundant spring moisture before summer and its associated dry conditions and high temperatures force limitations on growth.

Evergreen artemisias with the ability to endure drought conditions are termed “drought enduring” and include: *A. tridentata*, *A. arbuscula* ssp. *arbuscula*, *A. nova*, *A. pygmaea* and *A. rothrockii*. “Drought evading”

Species with fluorescence in shades of creamy blue:

Artemisia arbuscula ssp. *arbuscula*
A. arbuscula ssp. *thermopola*
A. cana ssp. *bolanderi*
A. cana ssp. *viscidula*
A. arbuscula ssp. *longiloba*
A. spiciformis
A. tridentata var. *vaseyana*
A. tripartita var. *tripartita*



Live *Artemisia tridentata* ssp. *vaseyana* with its leaves fluorescing blue under UV light.
 © Maddie Maher

Species with fluorescence in shades of brownish-red:

Artemisia nova
A. rigida
A. tridentata var. *tridentata*
A. tridentata var. *wyomingensis*

types include the deciduous species, such as: *A. cana*, *A. tripartita* and *A. rigida*. Generally, there is a continuum in reduction in leaf size from the large leaves of the more mesic species to the smaller leaves of the xeric species.

Other morphological features associated with artemisias—and other plants growing in dry environments—include leaf vein densities, which are generally greater than those found for the sun leaves of other deciduous dicots. Leaf hairs associated with this group of artemisias can be described as elevated “T”s that form an elevated layer over each leaf, forming a dead air space that is associated with a ►

◀ reduction in heat load and increasing light reflectance. This canopy undoubtedly reduces transpiration through the corresponding increases in relative humidity and reductions in leaf temperatures.

There is another leaf feature directly associated with decreasing moisture in the native environment: the width of individual water conducting vessels. Vessels of artemisias found in moist environments are wider than those of species from drier habitats. This undoubtedly corresponds to the greater vessel wall pressure, which must be endured by those species subjected to increasing drought with the progress of the growing season and the associated increases in internal cell osmotic pressure.

Since physiological research for different species is still in its infancy, researchers are usually very careful about making broad statements for each species or for the entire sagebrush group regarding any finding. Although this tact is important to science, individual findings are already providing what may prove to be important clues to handling these species in the landscape.

Not surprisingly, one of the most studied species is *A. tridentata* (big sagebrush) and its varieties, undoubtedly the most numerous and important shrub in western North America, where it is found growing over approximately 420,000 square miles.

Although reported adaptations to its environment may not prove similar for other species, the variety *wyomingensis* has been found to initiate root growth activity approximately one month before leaf growth, when soils are yet quite cold in the spring. This special adaptation may allow it to take special advantage of early and plentiful soil moisture before moistness becomes severely limited with the ensuing dry summer.

Root growth, water uptake, transpiration, and photosynthesis all have been found to occur with greater activity in the variety *tridentata* early in the

season when soil water is more available and when atmospheric moisture stress is less. The additional ability of this variety to extract soil water at -60 to -70 bars—much above the ability of plants from perennially more moist climates—enables it to survive in dry climates.

The evergreen nature of var. *tridentata* enables it to get a jump start on the growing season, not only by virtue of having leaves ready for photosynthesis on those warm spring days when deciduous species have not yet produced leaves, but also through the ability to conduct photosynthesis at temperatures hovering around the freezing mark. Another uncommon but enabling feature is the ability of the leaves to shift the optimum temperature at which photosynthesis takes place, from those leaf temperatures common in the spring to those experienced later in the season. This adaptive ability is greater than that yet found for *A. nova* or *A. arbuscula*. A study conducted in the White Mountains of California found the optimum temperature for photosynthetic efficiency for *A. tridentata* var. *tridentata* was 68°F, that for *A. nova* was 77°F and that for *A. arbuscula* was 60°F.

As might be expected for a species found growing over such a broad and diverse area, the control of photosynthesis and its adaptability to low temperatures has been found to be under genetic control for var. *tridentata*. These features probably explain better its adaptability to dry environments rather than any particular morphological leaf feature.

Unlike some other dryland adapted species, photosynthesis in var. *tridentata* is sensitive to leaf temperatures greater than 86°F and to water stress, to which there exists a very sensitive control of the leaf stomates. Since both of these conditions may be found early in the growing season, its ability to flourish in dryland or draughty areas is not simply explained through one simple adaptive ability or process. Its adaptive fit to maximum growth relatively early in the growing season is additionally enhanced through the production of special early season ephemeral leaves, which are shed when moisture stresses become severe.

Jim has been fooling around with native plants for more than 40 years in private, commercial, and public venues. His home garden contains 1000s of native plants, most grown from seed at home and now not supplementally watered for 20 years. Jim has written hundreds of articles, given talks too numerous to count, and continues to grow and plant the two or three native plants not yet in his garden. ☺



***Artemisia tridentata* var. *vaseyana*. © Maddie Maher**

Not All Bees Are Created Equal: Honeybee Apiaries on Public Lands and Consequences for Native Plants

By Ellie Stevenson

All lovers of native plants in Colorado know that many of the plants rely on insect and other animal pollinators for survival. As pollinators of approximately 75% of flowering plants in North America, native bees are of particular importance to a significant number of these plants (Ollerton et al. 2011). The term “native bees” encompasses an incredibly diverse suite of creatures, with over 4,000 species in North America and especially high diversity in the Four Corners area: there are 1,000-1,300 in New Mexico, Utah, and Arizona! (Scott et al. 2011; Buchmann et al.; Carril 2019; Tepedino 2019) These native bees differ a bit from the yellow and black fellows many people recognize as bees, which are actually one species, the non-native European honeybee (*Apis mellifera*). Most native bee species are solitary, and nest in wood, plant materials, or the ground rather than the large hives that may come to mind. These solitary bees are mostly single mothers that raise just a few young a year, and belong to species that vary widely in size, color (some are even metallic!), and behavior.

One key aspect of native bee diversity is the complex relationships between bees and the plants they pollinate. Native bees and plants in Colorado and elsewhere have evolved together, and in some cases are so interdependent that a plant species may rely on a limited number of bee species for pollination, or a bee species may rely on a limited number of plant species for pollen. For example, a University of Colorado Museum of Natural History inventory of bees in Colorado lists more than 20 native bee species that each collect pollen from just a single plant genus (Scott et al. 2011).

Disruption of this delicate balance between plant and pollinator is just one of the threats posed by the introduction of large numbers of honeybees to Colorado public lands via apiary permits issued by the Bureau of Land Management and the Forest Service. An apiary is a collection of managed beehives maintained by a beekeeper. In the US, the most commonly managed bee species is the European honeybee. Commercial pollination has become increasingly lucrative in recent decades, with numerous beekeeping companies participating in a massive, migratory pollination cycle following various crops around the country (Durant 2019; Rucker et al. 2019). These beekeepers must seek lands on which to pasture their honeybees when they are not pollinating crops.

However, during the same time period there have been both reductions in government programs that encourage conservation uses of private lands (e.g., growing plants that don't require plowing), and increased government incentives for growing biofuel crops, which do not provide good forage for bees (Otto et al. 2016; Otto et al. 2018; Durant & Otto 2019). Some dramatic reductions have occurred in areas of the Midwest that support a significant portion of commercially-managed honey bee colonies. Given this loss of forage, the damaging effects of pesticides, and the desire for a cost-effective method of feeding their bees, some beekeepers turn to public lands.

After learning of a request by Adee Honey Farms (the largest beekeeper in the nation) to pasture more than 9,000 hives on one national forest in Utah, the Grand ►



Native bees have diverse floral preferences, pollination behaviors – and appearance. © USGSBIML Team



A honeybee apiary on a national forest in Utah. © USGSBIML Team



This chimney bee, *Diadasia australis*, lives in Colorado. © Project Eleven Hundred

◀ Canyon Trust and Center for Biological Diversity began requesting records of apiary permits on the Colorado Plateau. They found that large numbers of non-native bees are being permitted on public lands: almost half of currently active apiary permits on the Colorado Plateau allow ~100 hives per site, and each hive may contain up to 60,000 honeybees. Unfortunately, the placement of honeybee apiaries in native bee habitat can negatively impact both native bees and plants in three keyways: competition with native bees, disease transmission between honeybees and native bees, and alteration of plant communities.

Given the large size of their hives and their foraging behavior, honeybees compete with native bees for the resources both need to survive. The most critical resource to consider is pollen, since it is both produced in limited quantities and is the main source of protein and nutrients required by bee larvae. One study estimated that one medium-sized honeybee hive could, in one month, remove the amount of pollen needed to raise 33,000 average-sized native bees. Applying this math to a 3-month, 100-hive apiary permit, those honeybees could consume enough pollen for roughly 10 million native bees. In addition to their large numbers, honeybees are more efficient at collecting pollen due to their foraging behavior, putting solitary native bees at a disadvantage (Henry & Rodet 2018). The impacts of this competition, or even just the presence of honeybees, may be wide-ranging. Proximity to honeybees has been found to reduce native bee rates of visitation to flowers, offspring production, and diversity (Torné-Noguera et al. 2016; Paini & Roberts 2005; Badano & Vergara 2011).

In addition to competition for resources, honeybees pose a threat to native bees via disease transmission, which has emerged as a serious issue for both managed bees and wild native bees. Honeybees can be exposed to a variety of pathogens while pollinating

crops, which they can then transfer to native bee populations in summer pasture areas (Cavigli et al. 2016; Gisder & Genersch 2017). Studies have indicated that diseases can be passed between bees at flowers, including debilitating pathogens such as deformed wing virus and black queen cell virus (Genersch et al. 2006, Peng et al. 2011). There is also evidence that the impacts of disease on native bees can be compounded by the effects of competition. A lack of nutrition and increased energy expended on resource collection (both potential consequences of competing for pollen) can reduce bees' ability to manage infections (Brown et al. 2000; USFWS 2018; Goulson et al. 2015).

The negative impacts of honeybee competition and disease transmission on native bee populations necessarily threaten native plants that depend on them for pollination. As noted above, the co-evolution of native plants and bees means that some plant species have specialized relationships with their pollinators and may require a native bee with certain attributes for pollination. As a non-native species, honeybees have not evolved with any of Colorado's native plants and are generally not as effective pollinators as native bees (Geslin et al. 2017; Russo 2016). This may be especially consequential for rare or range-restricted plants that depend on specific native pollinators for survival (Norfolk et al. 2018). While honeybees may pollinate some species as well as native bees, their ability to do so depends on a variety of factors, and which plants may benefit from or be disadvantaged by honeybee pollination is unpredictable. Thus, the ultimate impact of introducing large numbers of honeybees on the native flora of an area is impossible to know, but has the potential to deplete diversity in plant communities and thereby affect entire ecosystems. ▶



Parachute penstemon, *Penstemon debilis*, is a rare plant native to Western Colorado. It is federally listed as threatened, and is bee-pollinated. © Clayton Creed, U.S. Fish and Wildlife Service

◀ Given the evidence for the negative consequences of permitting honeybee apiaries, you may well be wondering how this practice is allowed on our public lands. There are already more than 75 Sensitive, Threatened, or Endangered species of plants on BLM and USFS lands in Colorado – why risk the survival of these species and others?

Unfortunately, one of the reasons it is easy for land managers to grant these permits is that both BLM and USFS regulations currently allow them via Categorical Exclusion from National Environmental Policy Act analysis. This means neither environmental assessment nor public input are required for approval of a multi-year permit. During 2020, four conservation organizations jointly filed separate petitions with both the US Department of Interior (BLM) and US Department of Agriculture (USFS) to eliminate the Categorical Exclusion authority.

In the meantime, the best way to advocate for native bees and plants is by contacting land managers directly. Some Field Managers (BLM) and District Rangers (USFS) may not even be familiar with this issue, or the potential impact of honeybee apiaries on the lands they manage. Contacting your local public land manager is both an opportunity to share the information they need in order to make knowledgeable decisions about apiary permitting, as well as to let them know that public lands users care about the impacts of honeybees on native plants and bees.

You can find the contacts for all current District Rangers and Forest Supervisors (USFS) and Field Office Managers (BLM) in the portion of Colorado that is on the Colorado Plateau at the following link: <https://docs.google.com/spreadsheets/d/1PHGRoubFY1hibJK2cl7TxKvIU4F4AjXtk7aHC61V8lg/edit?usp=sharing>

For more information and materials that you can share with others, go to: <https://drive.google.com/drive/folders/13IZLZwxQhK2O5nZ1eZMaELTBACwmoff9?usp=sharing>

Project Eleven Hundred (named for the approximate average number of native bee species in Colorado, Utah, Arizona, and New Mexico) has recently been established as a Utah nonprofit to end and prevent the permitting of honeybee hives on Forest Service and BLM lands on the Colorado Plateau. For more information, contact Mary O'Brien at maryobrien10@gmail.com.

Ellie Stevenson served as Pollinator Fellow at Grand Canyon Trust from March to December 2020, and currently serves on the Board of Directors for Project Eleven Hundred. She has worked in the non-profit sector for the past eight years at organizations with missions from youth

workforce development to health education. In 2018, she began working for organizations with an environmental focus to better fit her passion for the natural world. An avid hiker, backpacker, and biker, she loves exploring as much of the Southwest as possible! Spending time in these landscapes inspires her to do her best to protect them, so we can all continue to enjoy and learn from these places for generations to come.

References

- Badano EI and Vergara CH. (2011) Potential negative effects of exotic honey bees on the diversity of native pollinators and yield of highland coffee plantations. *Agricultural and Forest Entomology* 13(4):365-372.
- Brown MJF, Loosli R, and Schmid-Hempel P. (2000) Condition-dependent expression of virulence in a trypanosome infecting bumblebees. *Oikos* 91:421–427.
- Buchmann SL, Bealmear S, Prajzner S, and Wojcik V. Arizona Bee Identification Guide. The University of Arizona. <https://acis.cals.arizona.edu/pest-identification/pest-diagnostics/arizona-bee-identification-guide>
- Carril OM. (2019) What native bees live in northern New Mexico? New bee inventory sheds light. Institute for Applied Ecology. <https://appliedeco.org/essential-to-bee-conservation-southwest-bee-inventory-work/>
- Cavigli I, Daughenbaugh DF, Martin M, Lerch M, Banner K, Garcia E, Brutscher LM, and Flenniken ML. (2016) Pathogen prevalence and abundance in honey bee colonies involved in almond pollination. *Apidologie* 47:251-266.
- Durant JL and Otto CR. (2019) Feeling the sting? Addressing land-use changes can mitigate bee declines. *Land Use Policy* 87:104005(1-8). <https://doi.org/10.1016/j.landusepol.2019.05.024>
- Durant JL. (2019) Where have all the flowers gone? Honey bee declines and exclusions from floral resources. *J Rural Studies* 65: 161-171.
- Genersch E, Yue C, Fries I, and de Miranda JR. (2006). Detection of Deformed Wing Virus, a honey bee viral pathogen, in bumble bees (*Bombus terrestris* and *Bombus pascuorum*) with wing deformities. *J Invertebrate Pathology* 91:61-63.
- Geslin B, Gauzens B, Baude M, Dajoz I, Fontaine C, Henry M, Ropars L, Rollin O, Thébault E, and Vereecken NJ. (2017) Massively introduced managed species and their consequences for plant–pollinator interactions. *Adv Ecol Res.* 57: 147-199.
- Gisder S and Genersch E. (2017). Viruses of commercialized insect pollinators. *J Invertebrate Path.* 147: 51-59.
- Goulson D, Nicholls E, Botías C, and Rotheray EL. (2015). Bee declines driven by combined stress from parasites, pesticides, and lack of flowers. *Science* 347:1255957.
- Henry M and Rodet G. (2018) Controlling the impact of the managed honeybee on wild bees in protected areas. *Scientific Reports.* 8:1-10. ►

Love of Life

By Arthur Clifford

Something of life is understood
Standing silent in a winter wood
Snowflakes spiral to the ground
Shattering there without a sound
Frozen tears of a Heavenly race
Feathery angels dressed in Grace
On living cheeks they melt away
As if in passing to convey
A kiss upon the mortal face
Oh...
To stand here in our place
To feel the snow upon warm skin
To walk on earth
To live again



Glacier Gorge, Rocky Mountain National Park.
© Kelly Ambler

Recent and Relevant Reading

Winter is the perfect time to catch up on reading about native plants.

“Ascent of the Oaks: How Oak Trees Evolved to Rule the Forests of the Northern Hemisphere.” Discover how genomes and fossils reveal their remarkable evolutionary history. *Scientific American* (August 2020)

“Don’t Crush that Ant—It Could Plant a Wildflower.” New findings show how ants choose and protect the seeds they disperse. *Science* (14 August 2020)

“The mystery of the blue flower: nature’s rare colour owes its existence to bee vision.” Plants may have evolved blue pigment production for the benefit of attracting bees or other pollinating insects. *The Conversation* (24 January 2021)

◀ Norfolk O, Gilbert F, and Eichhorn MP. (2018) Alien honeybees increase pollination risks for range-restricted plants. *Diversity and Distributions*. 24:705-713.

Ollerton J, Winfree R, and Tarrant S. (2011) How many flowering plants are pollinated by animals? *Oikos* 120:321–326.

Otto CRV, Rotha CL, Carlson BL, and Smart MD. (2016) Land-use change reduces habitat suitability for supporting managed honey bee colonies in the Northern Great Plains. *PNAS* 113:10430–10435.

Otto CRV, Zheng H, Gallant AL, Iovanna R, Carlson BL, Smart MD, and Hyberg S. (2018) Past role and future outlook of the Conservation Reserve Program for supporting honey bees in the Great Plains. *PNAS* 115:7629–7634.

Paini DR and Roberts JD. (2005) Commercial honey bees (*Apis mellifera*) reduce the fecundity of an Australian native bee (*Hylaeus alcyoneus*). *Biological Conservation*. 123:103-112.

Peng W, Li J, Boncristiani H, Strange J P, Hamilton M, and Chen Y. (2011) Host range expansion of honey bee Black Queen Cell Virus in the bumble bee, *Bombus huntii*. *Apidologie*. 42:650-658.

Rucker RR, Thurman WN, and Burgett M. (2019) Honeybee mortality, markets, and the food supply. *Choices*. 34:1-9.

Russo L. (2016) Positive and negative impacts of non-native bee species around the world. *Insects*. 7:69.

Scott VL, Ascher JS, Griswold T, and Nufio CR. (2011) The bees of Colorado. Natural History Inventory of Colorado No. 23. University of Colorado Museum of Natural History. https://www.colorado.edu/cumuseum/sites/default/files/attached-files/the_bees_of_colorado.pdf.

Meinzen T. (2019) The Buzz on Utah's Bees with Dr. Vince Tepedino. Grand Canyon Trust. <https://www.grandcanyontrust.org/blog/utah-bees-vince-tepedino>

Torné-Noguera A, Rodrigo A, Osorio S, and Bosch J. (2016) Collateral effects of beekeeping: Impacts on pollen-nectar resources and wild bee communities. *Basic and Applied Ecology*. 17:199-209.

United States Fish and Wildlife Service (2018) Franklin’s bumble bee (*Bombus franklini*) Species Status Assessment. Final Report, Version 1, p. 39. 🌀

Correction

The photo on page 25 of the Fall issue of *Aquilegia* (issue #44.4) should read “Big sagebrush (*Artemisia tridentata*) stem with the medusa-like galls of the *Rhopalomyia* mite on its stem.”

News, Events, and Announcements

Please check the **Calendar of Events** online at <https://conps.org/mfm-event-calendar/#!calendar> for chapter meetings, garden tours, and other events. With the evolving COVID-19 situation, CoNPS is not hosting any in-person events. The status of future CoNPS events might also change.

CoNPS may offer some chapter meetings, workshops, and lectures as webinars or other online meetings. Others might be postponed or canceled. Field trips are also being scheduled, but may be canceled or postponed. These will be posted online and will be promoted via the CoNPS E-News.

CoNPS Committee Updates

Education and Outreach

CoNPS seeks a new chairperson of the Education and Outreach Committee. After serving in that role for almost 4½ years, David Julie stepped down at the end of 2020.

The E&O committee provides educational programs to the community to share our love and knowledge of native plants. Committee members also participate in events to increase the visibility of CoNPS.

Please contact David (bldrjardin@live.com) if you have questions about the role or Linda Smith (conpsoffice@gmail.com) if you would like to volunteer.

Horticulture Committee Highlights

By Ann Grant

The Horticulture Committee ran a booth for CoNPS at the "Landscaping with Native Plants Conference" in February 2020. We handed out information on the many resources that we have on gardening, and about 60 people stopped by, many of them taking away membership applications.

A promotional brochure, "Why Garden with Native Plants?" was rewritten and updated for distribution at the Conference. The full-color brochure was illustrated with natives and pollinators in watercolor by Sue Quinlan.

The Horticulture Committee made a total of ten awards in 2020 for Certified Native Plant Gardens: eight in the "Gold" category, and two in "Silver". Criteria include cool and warm season grasses, nectar and pollen resources for pollinators, and nitrogen-fixing plants from the Fabaceae family. Applications can be downloaded from the CoNPS website, or by sending a request to conpsgarden@gmail.com. The application can be used as a guide in garden planning.

About a dozen requests for information on Native Gardens were fielded by the Committee.

Citizen Science

By Ann Grant, Paul Alaback and Maggie Gaddis

The Citizen Science team got started with new initiatives in **Project Budburst** and **iNaturalist**. The Budburst website is being significantly revised by its host, the Chicago Botanic Garden. A phone app is in beta testing, with some CoNPS members trying it out. Soon our Society will have a CoNPS Project on the website, with much easier data entry. For more information, email budburstcolorado@gmail.com

The team launched a new iNaturalist Working Group to help improve the quality of observations made in Colorado. Watch the Event Calendar for scheduled meetings, or for more information, email Maggie Gaddis at ecocitycoloradosprings@gmail.com

Field Studies Committee

By Lara Duran

The Field Studies Committee is all about planning specialized events. Our committee does not host social field trips, training or workshops. As co-chair, I've been trying to: 1) organize committee members; 2) plan events to fill important information gaps; 3) spread events out geographically over the whole state; 4) spread events out over a variety of landowner/agency sites; and 5) spread events over the field season.

To organize committee members, I created a Google form that interested members can fill out to link their interests with the different needs of the Field Studies Committee. That form is on our website. This helps us see who wants to be on the committee, what their contact info is, their skill level, and what they might want to do to help. Those forms go to our Google Drive database. The Google database is used to contact members about once or twice a year to start the planning process for the upcoming field season. We have a lot of committee members, but few end up participating in the planning meetings. These meetings will be advertised in advance. ►

◀ To plan events to fill important information gaps, we focus on specialized botanical field needs. Often these are at the request of an agency or landowner, or for some other highly specialized purpose. Additionally, ideas for specialized projects are solicited at the committee meetings. We discuss the logistics, time of year, number of people, hosting site/agency, specialized skills, whether sensitive information will be collected, funding costs, and coordination with the CoNPS Board, announcements, etc. Then, a leader is assigned, as well as anyone else that needs to support that project. The leader typically leads the event, coordinating with the landowner and subject matter experts. If the event is open to the general membership, the leader will also coordinate with Linda Smith, CoNPS administrative coordinator, so we can get the word out about the event and get it posted on the website. Many of our events require highly specialized skills or deal with sensitive information, so we tend to control participation in those events. However, we also try to include at least one event that is open to the general membership.

The event leader is responsible for ensuring the data collected is delivered appropriately. We desire this data to go into SEINet, but this always depends on the agreements made with the agency/landowner, and whether the data is sensitive.

To spread events out over the whole state, over a variety of landowner/agency sites, and over the field season, we prioritize the information gaps and events. Often, we have too many ideas. Having a good

justification for the field event is an important part of the prioritization process. It is a balancing act to consider the geographic area, time of year, etc. We had some great plans in place last year, but ended having to cancel all of them due to COVID-19. This year, I encourage committee members to consider if we can host a trip in a manner that keeps everyone participating 100% safe. Flexibility is key.

Once the events are decided, we proceed with getting them implemented. At that point, it is up to the leader to reach out if they want or need additional support from the rest of the committee for the logistics and implementation.

One point that is often misunderstood: when we host a field event, participants need to be on the Field Studies Committee. Members who want to participate in an open Field Studies event can sign up for it once it is advertised on the calendar and CoNPS website.

Research Grants Committee

The deadline for 2021 research grant applications is February 15. Apply at our website:

<https://conps.org/volunteer-for-committees/research-grants/> The Marr Fund supports research on the biology of Colorado native plants and plant communities. The Steinkamp Fund supports research on the biology of Colorado rare native plants. For additional information, please contact Stephen Stern stern.r.stephen@gmail.com Recipients of the awards summarize their studies for publication in the Society's newsletter, *Aquilegia*, and on this web site.

CoNPS Chapter Updates

Metro-Denver Chapter

After several years as Chapter president, Lenore Mitchell has stepped down. We are extremely grateful to Lenore for her outstanding leadership throughout her tenure!

We are excited to announce that new leadership is in place. The new Team is currently working on scheduling speakers and events for 2021. Please contact the Chapter (metrodenverconps@gmail.com) for more information or if you would like to join the team.

The new Leadership Team members are:



Dina Baker has been a part of CoNPS for over three years and is elated to be joining the Metro Chapter's Leadership Committee. She has her Native Plant Master® Certification from CSU Extension, Audubon Master Birder Certification,

Naturalist Training from Denver Audubon, and an MA in Teaching Biological Science from Miami University. Dina's passion is helping children and adults connect to nature through exploration and educational programming. In her free time, Dina creates nature-themed ceramic art, drawings, and paintings. She volunteers with Denver Audubon and leads educational programs for Evergreen Audubon. Dina loves trail running, hiking, botanizing, and spending time with her three dogs.



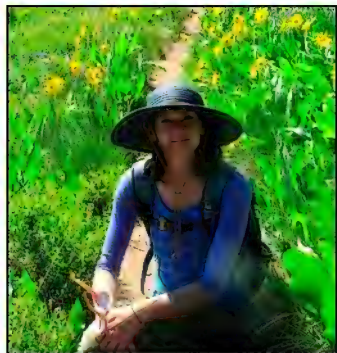
Emily Clapper has been a member of CoNPS for four years and is excited to be a part of the Denver Metro Leadership Team. She will be primarily assisting with outreach efforts and field trip planning, and other areas as needed. Emily has been working in local government for over 14 years and is a ►

◀ Management Analyst with the Town of Superior. Emily holds a master's degree in Public Administration with an emphasis on urban management. She is passionate about providing healthy habitats for native pollinators and water conservation. This past year Emily replaced her suburban front yard lawn with Colorado native plants. Her favorite Colorado native plants are Apache plume and pasqueflowers.



Rahman Minhas is a Denver native and currently works for the City & County of Denver in the Natural Areas Program as a horticulturist. Growing up, he was taught the value of plants from his father. He pursued that passion into adulthood, learning as much as he can

about native plants and ecology from books, people, and exploring.



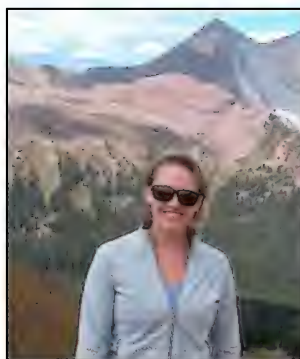
Lindsay Nerad has worked over a decade in various forms of horticulture. She started working on small-scale organic farms, then moved to urban farming and garden maintenance. Wanting to have a greater impact with her work, she pursued a master's degree in Conservation Leadership.

After receiving her masters, she realized she could play a vital role in preserving the natural heritage of the Front Range by promoting native flora in Denver communities. In 2018 Lindsay received a Landscape Design certification and has dedicated herself to designing and installing gardens abundant in Colorado native plants. Lindsay loves all things nature...birding, photographing native flora, hiking, climbing, kayaking, and camping are some of her favorite hobbies.



Rachel Puttmann has been an environmental consultant for over 14 years with a focus on wetland ecology. Rachel is a Colorado native with a Master's degree in Environmental Sciences from the University of Colorado - Denver. In her free time, she enjoys hiking

with her dog, Jedi, playing soccer, and snowboarding. She is looking forward to being part of the CoNPS Metro-Denver Leadership Team and excited to learn more about native plants and pollinators.



Audrey Spencer is an early-career botanist interested in the biogeographic origins of the flora of the Southern Rocky Mountains. She completed her Masters degree from the University of Colorado Denver in 2019—advised by Dr. Leo Bruederle, who was also co-author on a taxonomic paper recently

published in *The Journal of the Torrey Botanical Society*. She has worked several seasons for the Denver Botanic Gardens and, most recently, for the Resource Stewardship program at Colorado Parks and Wildlife. In her free time, she enjoys botanizing while hiking and camping with her husband, Ryan, and their poodle puppy, Stella.

Northern Chapter

In October, the Northern Chapter held a Native Seed Swap with partners Wild Ones Front Range Chapter, People and Pollinators Network, Wildlands Restoration Volunteers, and Nature in the City.

Thanks to the volunteers who donated seeds and helped set up and take down the event, which was held in Sugar Beet Park, Fort Collins' newest city park, which has a native plant garden, planted last year with the help of more volunteers. Stats on the event and the photo album were provided by WRV.

- **Final Count:** 49 attending, estimated: 11 male, 38 female, 30 aged 18-54 and 19 in the +54 category.
- **Volunteer hours:** 80 hours of time cleaning and repackaging seeds, 6 hours during event and another 18 hours (3 hours for 6 of us) for set up and cleanup, for a total of **104 Volunteer hours!**
- **Link to Flickr Photo album:**
<https://flic.kr/s/aHsmRLPLae> for sharing within your respective organizations.

Watch our Calendar for another **Seed Swap** in the fall of 2021 and a **Native Plant Swap** in the works for Spring of 2021.

Virtual Plant Hikes were held with members contributing pictures and oral commentary on trips made during the summer. **Hugh MacKay** led off with slides from several trips up Young Gulch, which was newly reopened after the fires and floods of 2013. **Rob Pickett** made a 3-day backpack up the Dunraven Trail to treeline. His finds included the elusive wood lily.

River's Edge Native Plant Gardens, Kathleen Maher.

In 2019, two native gardens were installed at the River's Edge Natural Area in Loveland. This year, the ►

◀ gardens were augmented with additional plants donated by High Plains Environmental Center.

On planting day in September, 19 volunteers spent a total of 30 hours digging holes in rocky, gravelly "soil" and planting the natives. For the next 6 weeks, 4 more volunteers showed up to water the plants for another 8 hours. Throughout the season, at least 12 Weed Warriors donated over 60 hours to weeding. In addition, there were two sessions of weed ID training with 7 participants each, for another 12 hours.

A highlight of the gardens is plant descriptions that are available online <https://rena-demo-gardens.tumblr.com/>; more descriptions are being edited and added. Ten volunteers wrote up 40 plant descriptions. Considering that each description requires about 4 hours to research and write up, an amazing 160 hrs were volunteered.

In 2020 alone, volunteer hours totaled 270.

Southeast Chapter

2021 CoNPS Annual Meeting Planning

Join the Annual Meeting committee to pass the COVID times and support our once-per-year

opportunity to get together en masse. We are planning a live and virtual conference to meet any conditions 2021 might unfurl. We will meet monthly and participation in a subcommittee will be expected. Subcommittees will be arranged around general categories like venue, food, speakers, field trips, photo contest, bookstore, etc. Please contact Denise Wilson (deniseclairewilson@gmail.com) or Maggie Gaddis (ecocitycoloradosprings@gmail.com) if you are interested in participating.

Native Plant Master Program Revival Effort

CoNPS member and El Paso County Extension Agent Irene Shonle is seeking our support to re-engage the Native Plant Master Program in Southern Colorado. If you are interested in this project, please contact Irene Shonle (Irene.Shonle@colostate.edu) or Maggie Gaddis (ecocitycoloradosprings@gmail.com).

All of this information AND recordings of December virtual events are on our webpage:

<https://conps.org/about-us/chapters/southeast-chapter/>

CoNPS Webinars

CoNPS offers webinars on a variety of native plant topics. Sign up for these webinars on the CoNPS website (<https://conps.org/mfm-event-calendar/#!calendar>). New webinars are constantly being added to the calendar.



Habitat Gardening and Native Plants for Year-Round Interest

February 6, 9:30 AM–NOON

Presenter: Irene Shonle, PhD

Waitlist only

Want to bring beauty to your garden while making a difference for our native pollinators and birds, right in your own yard? This webinar is for you! It is designed for beginner and intermediate gardeners or anyone who wants to create an oasis for pollinators and other wildlife while bringing more color and beauty into the world. The first half of this webinar will cover the importance and how-tos of habitat gardening. The second half will discuss what to plant for color, texture, etc. for year-round interest—delighting both you and the creatures that inhabit your garden.

CoNPS Chapter Events

(Please go to the CoNPS event calendar for information on attending any events.)

<https://conps.org/mfm-event-calendar/#!calendar>

Boulder Chapter

History of Shortgrass Prairie and Hightower Spring Ranch

March 11, 7-8:30 PM

Presenter: Michael Stanley, partial owner of Hightower Spring Ranch

Co-hosted by the Northern Chapter

Michael will discuss the formation of Colorado's shortgrass prairie and some of the issues it faces today. Then he will discuss the history and ecology of Hightower Spring Ranch located in Weld County, CO.



Michael grew up in the shortgrass prairie of Colorado and spent a lot of time in the Pawnee National Grasslands. He received a B.S. from Colorado State University in Wildlife

Biology and minored in Botany. He made a career in Law Enforcement and Security and spent some time in the military. Now he is a partial owner of Hightower Spring Ranch. He self-published a book, "Plants of Hightower Spring Ranch" and is in the process of writing a book on the plants of the Pawnee National Grasslands.

The Genetic Basis of Fungal Adaptation

April 8, 7-8:30 PM

Presenter: Dr. Sara Branco, Assistant Professor, Department of Integrative Biology, University of Colorado Denver.

Dr. Branco will report her work on mycorrhizal fungal heavy metal tolerance. She has been studying the genus *Suillus*, a group of widespread temperate fungi that are mutual obligates of conifer trees and well-known for including species that can survive in highly contaminated soils. The talk will cover the latest findings on the mechanisms of metal tolerance and its implications for the tree partners. For login information for the virtual meeting, email

boulderconps@gmail.com

Metro-Denver Chapter

Building a Wildlife Habitat Community

February 9, 6:30-8:30 PM

Presenter: Catherine Zimmerman

Catherine Zimmerman will discuss the National Wildlife Federation's Community Wildlife Habitat Program. She will highlight the importance of native plants and their roles in building wildlife-friendly spaces, and describe how she was able to inspire her small village in Ohio to become a certified Wildlife Habitat Community.

Hometown Habitat: Stories of Bringing Nature Home!

Stream the film online on February 5, 6, and 7.

Rewilding and Ecotherapy with Native Plants

Tuesday, March 9, 6:30-8:30pm

Presenter: Kimberly Beck

Kimberly operates Relational Rewilding and is on the faculty of the Gestalt Equine Institute of the Rockies, which teaches nature-based approaches to therapy. Relational Rewilding Nature Guiding fosters mutually enhancing relationships between people and nature,

thereby inspiring ecological literacy, environmental participation, and inner wilderness exploration. Kimberly will discuss the role of native plants in ecotherapy.

The Pollinator District in Broomfield

April 13, 6:30–8:30 PM

Presenter: Amy Yarger

Amy will introduce us to the Pollinator District and focus on how it will utilize links between native plants and pollinators. This is a collaborative effort between city, development agencies, and non-profits.

Northern Chapter

History of Shortgrass Prairie and Hightower Spring Ranch

March 11, 7-8:30 PM

Presenter: Michael Stanley, partial owner of Hightower Spring Ranch

Co-hosted by the Boulder Chapter

Michael will discuss the formation of Colorado's shortgrass prairie and some of the issues it faces today. Then he will discuss the history and ecology of Hightower Spring Ranch located in Weld County, CO.

Photo Recognition and Plant Identification—What Those Apps Look for in Your Pictures

April 6, 7–8:30 PM

Presenters: Ernie Marx and Rob Raymond

Photo recognition apps are increasingly popular among native plant enthusiasts. They can be fun and rewarding to use, or frustrating and seemingly incapable of identifying a flower. A general understanding of how image recognition works can guide users towards taking pictures which yield better results. The session will include techniques for successful use of photo recognition and results from testing of several of the more popular apps.

Southeast Chapter

iNaturalist Virtual Working Group Meetings

February 8, 6-7:30 pm

Join us in this statewide effort to curate iNaturalist observations while honing our botanical key skills. While iNaturalist is fun to use in the field, it is even more educational when used at home to identify species observations. We are working to curate species that will also be used in the CoNPS Budburst Citizen Science Project. Check the CoNPS calendar for details.

Other CoNPS Events

March 7, 1–2 PM

Virtual Garden Tour

Amy Yarger, Butterfly Pavilion, “The Urban Prairies Project: Habitats for People & Pollinators”

Urban open spaces perform vital ecosystem services, support wildlife habitat and connect people to the natural world...but many of them face substantial challenges. In this virtual tour, Amy will demonstrate how mobilizing community stewards can make a difference for native plants and the creatures (including us) that rely upon them.



March 21, 1–2 PM
Virtual Garden Tour
Cynthia Reiners, “From Lawn to Xeriscape; Retrofitting a Small Suburban Landscape”

Beginning in the late 90’s, Cynthia has been converting the front yard lawn in a traditional neighborhood to dry-scape and drip irrigated gardens. A large portion was planted with natives rescued from a Highlands Ranch site prior to development. The gardens have been augmented with other xeric adapted natives and non-natives. The resulting landscape attracts wildlife. This program is a practical how-to guide.

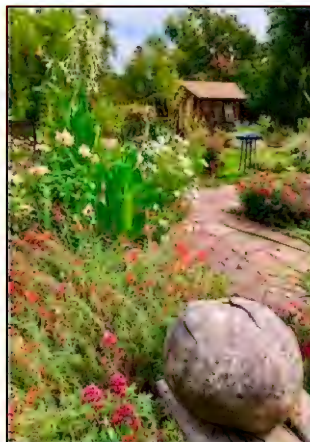
May 15 (snow/freeze alternate date May 21)
CoNPS Native Plant Sale

Customers place their orders, pay *and* schedule a pick-up location and time, right in the CoNPS website. Pick-up locations at Chatfield Farms, Golden, and Colorado Springs.

June 5, 9 AM – 5 PM

In-person South Denver Garden Tour

Donna Baker-Brenningstal’s garden (pictured, above right) is featured in this year’s Denver Garden Tour,



along with other award-winning gardens: Panayoti Kelaidis’ personal garden (Denver Botanic Gardens), Marcia Tatroe, author, Cindy Newlander (also of Denver Botanic Gardens), Jenifer Heath, and the public garden, Babi Yar Memorial Park. Join the tour for inspiration!



June 12, 9 AM – 5 PM
In-person Loveland-Fort Collins Garden Tour

John Giordanengo’s backyard wetland (pictured, left), is one of the extraordinary gardens offered on this tour. Other hosts will include Annemarie Fussell (of Wildlands Restoration Volunteers) and the conservation gardens of Rivers Edge.

June 26, 9 AM – 5 PM

In-person Boulder-Longmont Garden Tour

Our Boulder and Longmont members have some beautiful gardens, and this year we get to see some new ones! Our hosts include Ron Wittmann, author of the *Flora of Colorado* books, Stuart Cummings, a CoNPS Gold Certified Native Garden, Dave Sutherland, retired Boulder Parks, Ingrid Moore, a Habitat Heroes garden, and the CSU Extension office in Longmont’s native demonstration garden.

Cross-Pollination Events

February 1-28

Virtual Colorado Garden and Home Show

<https://www.expocadweb.com/2021ghs/ec/forms/attendee/index5.aspx?mode=sales#fpPanel>

February 15

Application deadline. The Boulder County Nature Association is pleased to offer research funding as small, one-year grants for projects consistent with our mission. For more information, visit the website: www.bcna.org

February 17-16

RiversEdge West Virtual Conference

<https://riversedgewest.org/events/2021-conference>

February 27

Landscaping with Colorado Native Plants Conference

<https://pheedloop.com/EVEMSJHPTZKRI/site/home/>

March 5, 8:30 AM

7th Annual Tree Diversity Conference - ONLINE

Hosted by Denver Botanic Gardens

<https://www.botanicgardens.org/programs/2021-7th-annual-tree-diversity-conference-online>

March 27-October 6

High School Level Permaculture Design Course

<https://boulderdpdc.com/highschoolpdc/>

In Memoriam: Gayle Weinstein

July 1, 1942 - December 2, 2020

Amateur Botanist, Friend, and Mentor

By Jim Borland and Rick Brune

The native plant community lost one of its stalwart leaders last year when Gayle Weinstein died in December. Gayle was a former president of the Society and Director of Plant Collections at Denver Botanic Gardens, a recipient of a Special Merit Award from the Colorado Native Plant Society, and instrumental in building gardens composed strictly of native plants and, perhaps more importantly, incorporating them into conventional landscapes. She was tirelessly on the prowl, high and low, wet and dry for native plants to include inside and outside the Gardens with lectures, classes and demonstrations.

Author of *Woody Ornamentals for the Midwest*, *Xeriscape Handbook*, and *All About Dry Climate Gardening*, Gayle fostered her idea of creating a plant evaluation, promotion, and use program for plants that thrive in high plains and intermountain regions. Along with Colorado State University and local professional growers, this vision became the Plant Select® Program. For this and other native plant promotions and activities, she was recognized by Lady Bird Johnson Wildflower Center, Colorado Native Plant Society, and the American Society of Landscape Architects, among others.

Native plants at the Denver Botanic Gardens that she specified can still be found in the Laura Smith Porter Plains Garden, Dryland Mesa Garden, and Roads Water Smart Garden. In a rather spontaneous moment, Gayle and Rick Brune decided to test a miniature prairie burn just as Nature does on the Plains. With only minor chastisements from her boss (after the fact), burns are now a standard event—but now with proper authority and permits, announcements and available firefighting equipment.

Not satisfied with merely designing gardens containing native plants, Gayle attempted to replicate on a small scale the ecosystem in which the plants resided. In the Laura Smith Porter Plains Garden at the Denver Botanic Gardens, this included reproducing some of the major plant communities of the Great Plains including shortgrass prairies, tallgrass prairies, prairie wetlands, and sandhills prairies. Truckloads of sand from the sandhills northeast of Denver were delivered to the Gardens, where deep, sand-filled pits were dug to accommodate the deep and massive roots of some of the sandhills plants.



Gayle Weinstein at the Denver Botanic Gardens in 1984. Image courtesy of Denver Botanic Gardens Helen Fowler Library Archives.

The Dryland Mesa Garden (an original Xeriscape garden) and Roads Water Smart Garden also contain plants found in their appropriate ecological position. Plants original to these gardens were primarily from western Colorado and adjoining canyonlands and deserts but a wider range of natives is now incorporated.

As manager of Denver's first Natural Areas Program, she

ensured the documentation of the plants of all major waterways and other undeveloped areas in Denver. This effort was later expanded to Denver Mountain Parks, beginning with O'Fallon and Corwina Parks. In the end, 37 undeveloped areas were surveyed and management plans completed. As a result of Gayle's survey, approximately 660 plant species were identified in the City and County of Denver. These included several surprising discoveries: a population of endemic *Ambrosia linearis* (streaked burr ragweed); a relict population of *Artemisia tridentata* (big sagebrush), *Ribes americanum* (American black currant), and *Osmorhiza longistylis* (sweet cicely); several infrequent sandhills species were found including *Astragalus lotiflorus* (lotus milkvetch), ►

◀ *Pediomelum digitatum* (palmleaf breadroot), and *Pediomelum hypogaeum* (subterranean breadroot).

Gayle also believed that all employees should understand the total picture of what she was trying to accomplish. She involved all stake holders, including mowing crews, contractors, and wildlife biologists in discussions, teaching sessions, and tours of areas that had the potential to re-establish the fundamental natural features that existed prior to development.

We will forever miss Gayle for her warm and loving personality. Her contagious and unending enthusiasm for native plants will remain with those who knew her for the rest of their lives. She inspired many Denver Botanic Gardens interns to pursue important careers in plant conservation. Without Gayle, we would not find nearly as many native plants in our landscapes to remind us of her. **WE MISS YOU GAYLE!"**

More than 40 years, Jim Borland knew and worked with Gayle at Denver Botanic Gardens, Denver Open Space, and during monthly lunches at one of her favorite Thai restaurants. During the early years, Jim grew any and all the plants Gayle wanted for the Gardens from seeds and cuttings from around the world. The major native plant collections and landscapes got their start then from propagules gathered from joint trips to the West Slope and

Pawnee National Grasslands. A large number of these, especially the woody species, can still be found throughout the Gardens today.

Jim studied and appreciated native plants while living in the four-corners of the nation. Professionally, he helped start what may have been the first native plant nursery and garden center in the nation, later moving on to the Denver Botanic Gardens as Plant Propagator and even later growing native plants from his home garden. Stories about his native plant garden have been published throughout the nation in books and articles and the garden itself has been a stopover by visitors local, national and international. Other endeavors have included operating lathe machines, manufacturing thermostats, handling ordnance for Navy planes and mis-behaving as a great uncle. He has written more than 300 articles, given more than 100 talks, and conducted numerous tours.

Rick Brune worked with Gayle at the Denver Botanic Gardens, researching and developing plantings for native gardens. He also does environmental surveys and has created his own prairie garden. ☞

<https://www.tributearchive.com/obituaries/19147429/Gayle-Weinstein/Denver/Colorado/Feldman-Mortuary>

In Memoriam: James Fuchs

February 1, 1954 - June 22, 2020

We also lost an amateur botanist in 2020. Jim Fuchs was an avid hiker and climber, exploring the region around Grand Junction. He received a degree in soil sciences at the University of Montana and later pursued a degree in Physical Therapy. He had worked as a soil scientist, physical therapist, and then as a plant surveyor with West Water Engineering. His favorite job: being paid to hike! Jim was a true Renaissance Man. He was self-taught in astronomy, and he self-published a book regarding the modern

constellations that was purchased worldwide. He also maintained a corresponding website that has been used and viewed in over 164 countries and territories (modernconstellations.com, which is, unfortunately,



no longer maintained or available). Jim felt fortunate to live in Mesa County with its incredible access to BLM land, the Mesa, and the Monument. He conducted a variety of studies on rare plants as he explored the region. He had developed a very useful website cataloging the plants of northwestern Colorado. Since this site is no longer active, we have also lost his contribution to Colorado botany. Jim loved gardening, cooking, developing programs on his computer, early sci-fi films, poetry, and hiking

thousands of miles on and off trail. Obituary adapted from

<https://www.legacy.com/obituaries/gjsentinel/obituary.aspx?n=james-fuchs&pid=196448592> ☞

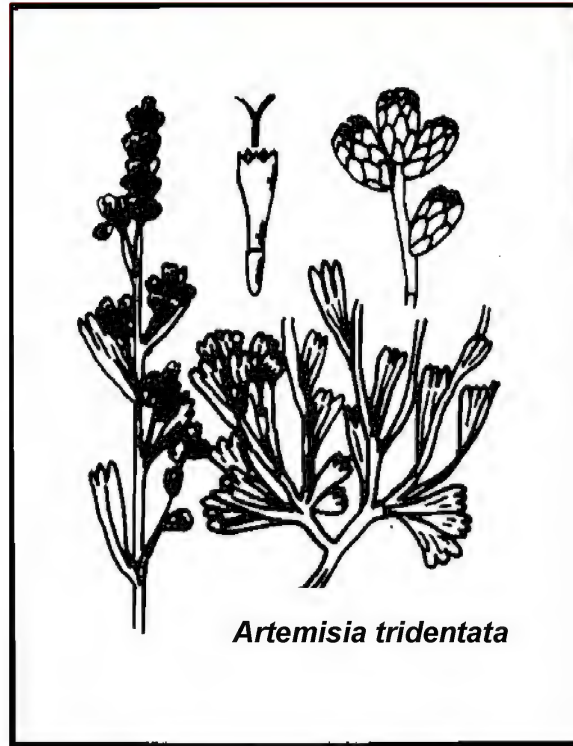
Editor's note: Aquilegia began in 1977 as a newsletter of the Colorado Native Plant Society, although it was not given this name until 1987. It primarily consisted of a calendar of events, notes of interest, editorials, listings of new members, and conservation news. Short articles were also occasionally included. Here are two such articles from 1977. KA

Dyeing with the Natives – *Artemisia* (sagebrush) **By Anne Bliss (CoNPS Newsletter, Vol. 1, No. 5)**

During the Middle Ages, people had trouble with insects which inhabited their homes, their garments (often worn in as many as six or more layers in the winter months), their animals, and their own bodies. At that time, such things as chemically synthesized insect repellents were not available, so people had to rely on naturally found repellents to discourage or get rid of insects. One family of aromatic plants seems to have been often used, either hung in animal sheds or houses, or used in cleaning the house. Old herbals often refer to branches of "wormwood" used as a broom to sweep out medieval cottages (and castles!) in the spring after the long "indoor days" of winter. Wormwood seems to be somewhat of a catch-all term applying to members of the sage or artemisia group. Whether they received this name because the plant was used to chase out insects, or because the larger stems/trunks appear to be worm-eaten, remains to be seen. Another possibility for this common name might be related to the practice of chewing leaves or making an infusion/tea of them to relieve indigestion (possibly intestinal worms?).

Other traditional uses of various species of *Artemisia* include treatments for colds (place bruised leaves in the nostrils), rheumatism (wrap yourself in bundles of sage and then apply heat—one wonders whether it was the sage or the heat that cured!), and to stop bleeding (chew some leaves and apply as a poultice). Some American Indian tribes favored local varieties of *Artemisia* above all other medicinal plants. This is not to say that this writer is necessarily advocating the use of *Artemisia* medicinally.

One excellent use for the local artemisias, of which Colorado boasts approximately fifteen species, is as a dyestuff. Methods for preparing fibers, mordant baths, and dyebaths are basically the same as for any other plant used to produce dye (see CoNPS Newsletter, Vol. 1, No. 4). For decades, Navajo Indians have used species of *Artemisia* to color the wool yarn they have spun and which they weave into their rugs and blankets. Excellent shades of gold, yellow, rust, ochre, green, and grey may be obtained by using a variety of metal salt mordants on wool. These colors rank as better than average in terms of lightfastness and



washfastness.

Artemisia tridentata Nutt. (big sagebrush), which is found in southern and western areas of Colorado, seems to produce the best results. This plant is easily identifiable because of its grey-green colored, three-toothed leaves, strong "sage" aroma, small yellow flowers late in the summer, and woody stems. The plant may grow to eight or more feet in height in areas where there is ample water. Though animals browse the plant, it is often pulled or burned out by ranchers preferring grassland. A good place to see plenty of this sage, smell it, and harvest some of it is in Middle Park (prune tender branches with leaves in the fall). Get permission if you are going on private property before you cut! While you are at it, get an extra sprig or two to dry and place among stored woolens to keep the moths away!

Dyeing with the Natives – *Salix amygdaloides* (peachleaf willow)

By Anne Bliss (CoNPS Newsletter, Vol. 1, No. 4)

Plants may or may not be edible, and we may die if we eat certain poisonous species. However, have you considered the possibilities for dyeing with or making dye from plants? The art and craft of dyeing with natural materials is as ancient as the first human who discovered that plants have pigments which stain skin.

The basic procedure for dyeing with plants is relatively simple, yet many colors may be obtained from a ►

◀ single plant. The results are determined both by the plant (and its chemical makeup) and the dyer. Some plant related variables include soil pH and mineral content, climate, amount of available water, time harvested, and elevation. Dyeing variables determined by the dyer include mordants (metal salts used to assist absorption and bonding of dye pigments, which may affect color), bath temperature, pH of the bath, length of time the plant is stewed, as well as length of time the material to be dyed remains in the mordant and dye baths. Quantity of mordant and plant will determine intensity of color and affect fastness.

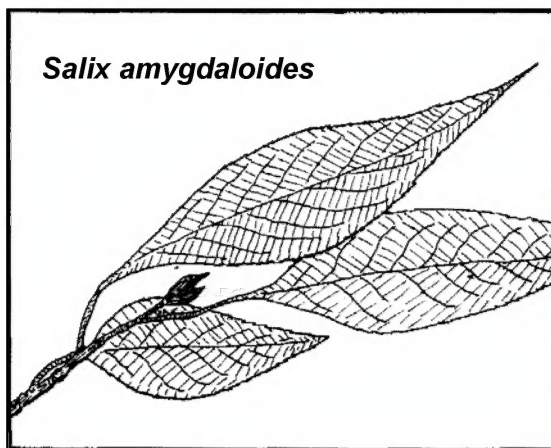
Numerous species of *Salix* (willow) grow throughout Colorado, either as domesticated or native plants. The water-loving native willow species can be found along streams on the plains as well as in wet tundra areas. Generally, willows are shrubs or trees characterized by flexible branches and oftentimes lanceolate leaves; however, identifying the various species is difficult as leaves and flowering parts must be checked throughout the growing season. Cottonwoods, poplars, and aspens are related plants and belong to the Salicaceae (willow family).

Salix amygdaloides (peachleaf willow) is a large (to about 50 feet) native tree which may be found along plains and foothill streams or rivers. Twigs bearing green leaves can be used to make a dye for wool which is fast to light and washing (i.e., it is lightfast and colorfast/washfast). Wool yarn or fabric dyed with leafy twigs from this willow species will have resultant colors which are similar to colors produced by dyes from aspen, poplar, and cottonwood trees. From a large tree growing approximately one mile from the mouth of Boulder Canyon, these colors were obtained:

Alum mordant: bright light yellow
 Chrome mordant: dark copper
 Copper mordant: greenish gold
 Iron mordant: medium olive green
 No mordant used: baby yellow
 Tin mordant: bright yellow

DYE PROCEDURE: Skein yarn and wet it, or wet fabric; place yarn or fabric in mordant bath and simmer (180-190°F.) for 1 hour, let yarn or fabric cool in bath (about 8 hours minimum). Remove yarn or fabric from mordant bath and rinse well to remove excess mordant. Place mordanted yarn/fabric in prepared dyebath and simmer 1 hour and let cool in dyebath. Remove yarn/fabric from dyebath and rinse until no more color comes out. Test for fastness by washing well with gentle soap or detergent (washfastness) and by placing a half covered piece of dyed material in the sun for 50-100 hours. Yarn/fabric should be dried out of the sun until fastness is determined.

PREPARING MORDANT BATH: For each pound of yarn/fabric mix the following quantities of metal salts



with 3-4 gallons of water. Metals salts are generally very poisonous, so handle with caution and good laboratory procedures--even in your kitchen!

Alum: Potassium Aluminum Sulfate-4 tblsp.

Chrome: Potassium Dichromate-3 tsp.

Copper: Copper Sulfate-2 tblsp.

Iron: Ferrous Sulfate-2 tblsp.

Tin: Stannous Chloride-2 tsp.

PREPARING DYE BATH: Collect 1 pound of plant material per pound of wool (increase or decrease amount of plant material once you have determined the ratio which will produce the desired color/shade). Cover this plant material (your DYESTUFF) with water and simmer 1 hour; let cool and then strain out plant material. If necessary add more water to give you about 4 gallons of dyebath per pound of wool.

NOTES:

1. Use a non-reactive pot for mordanting and dyeing, i.e., stainless steel or enamel/porcelain ware. Copper, tin, aluminum, and iron pots will release chemicals or metals and affect your dye color.
2. Keep lids on your pots and use **good** ventilation or fan.
3. Chrome, copper, and tin mordants (metal salts) are extremely poisonous. Alum and iron are not so poisonous, but still use with care. You may also use table salt, urine, alkali soil, reactive pots, and vinegar in lieu of the earlier mentioned mordants. Mordant comes from the French "mordre" meaning "to bite" which is partially what it does to the wool (or other natural fibers which can be dyed with plants).
4. Wear rubber gloves when rinsing.
5. Weeds make super dye!
6. Alpine plants, threatened or endangered species, area lichens, and plants which are not abundant and fast growing are best left growing—there are plenty of noxious weeds and fast growing/replacing plants to use for dyestuff.
7. Time duration for mordanting and dyeing is flexible--remove your material from the dyebath whenever the color suits you. ☺

CoNPS Membership

Name _____
 Address _____
 City _____ State _____ Zip _____
 Phone _____
 E-mail _____
 Chapter (if known) _____

CHAPTERS: Boulder, Metro-Denver, Northern (Ft. Collins-Greeley), Plateau (Grand Junction & West Slope), Southeast (Colorado Springs-Pueblo), Southwest (Durango) or Unaffiliated

If this is a change in address, please write your old address here.

Address _____
 City _____ State _____ Zip _____

☐ **Check box to receive information on volunteer opportunities**

DUES include the electronic version of the *Aquilegia* newsletter, published quarterly.

The full color electronic publication arrives by PDF in member email boxes in February, May, August, and November. For those members without email addresses, please apply for a scholarship to receive print copies.

Membership dues cover a 12-month period.

- ☐ New ☐ Renewal
- ☐ Student \$17 ☐ Senior (65+) \$17 ☐ Individual \$25
☐ Family \$35 ☐ Plant Lover \$50 ☐ Supporting \$100
☐ Patron \$250 ☐ Benefactor \$500 ☐ Life Member \$800

☐ **Printed Color Copy** of the magazine, *Aquilegia*, \$20

CONTRIBUTIONS to CoNPS are tax deductible:

John Marr fund for research on the biology and natural history of Colorado native plants \$ _____

Myrna P. Steinkamp Memorial fund for research, etc. on rare plants of Colorado \$ _____

Mission Grant Fund for research, etc. that support the mission of the Society \$ _____

Alice Eastwood Scholarship to support undergraduate scholarship on native plants \$ _____

Total included: \$ _____

Please make check payable to:

Colorado Native Plant Society

Send completed form and full remittance to:

CoNPS Office

PO Box 200

Fort Collins, CO 80522

You may also join online at <https://conps.org/about-us/committees/join-us/>



Sponsor for the 2020 CoNPS Annual Conference.

Thank you for your support and for the native plant stock that you provide!



Save the Date! CoNPS Annual Conference September 10-12, 2021 Trinidad, Colorado

We plan to open the registration early as many registrants will want to book a campsite for this destination conference. We are planning an in-person event, but members must keep an open mind: we may have to change to virtual format if COVID restrictions are required. We encourage those who intend to register to book a campsite at your earliest convenience.

Can You ID these Seedheads?



Answers (clockwise, from upper left): pearly everlasting (*Anaphalis margaritacea*, Asteraceae family), spotted coralroot (*Corallorhiza maculata*, Orchidaceae family), cutleaf coneflower (*Rudbeckia laciniata*, Asteraceae family), pinedrops (*Pterospora andromedea*, Ericaceae family), fireweed (*Chamenerion angustifolium*, Onagraceae), little pink elephantheads (*Pedicularis groenlandica*, Orobanchaceae family). © Marlene Borneman

Colorado Native Plant Society



P.O. Box 200
Fort Collins, Colorado 80522
<http://www.conps.org>

Save the Date!
CoNPS Plant Sale
May 15, 2021
Order online soon!
Pickup at Chatfield
Farms, Golden, or
Colorado Springs



CoNPS is pleased to announce the 2021 garden tours! We will kick off the season with two virtual tours, starting in March. Then in June, we have scheduled three in-person garden tours, which will be held with appropriate COVID restrictions. The first will be six gardens in south Denver. The second tour is in the Loveland-Fort Collins area, featuring six different gardens. The third garden tour will be in the Boulder-Niwot-Longmont area featuring six individual gardens, including Ron Wittmann's garden, whose photo appears to the left. See page 26 for more details.